PROPOSED

TOTAL MAXIMUM DAILY LOAD (TMDL)

For

Dissolved Oxygen and Nutrients

In The Everglades

(WBIDs 3252A, 3252B, 3252C, 3260, 3263, 3265B)

Hendry, Broward, Palm Beach,

and Dade Counties, Florida

Prepared by:

US EPA Region 4
61 Forsyth Street SW
Atlanta, Georgia 30303

September 2007

TABLE OF CONTENTS

LIST OF TABLES

ABBREVIATIONS

Ac-ft	acre-feet
AW FWMC	Farm area-weighted flow-weighted mean concentration
BMP	Best Management Practices
DO	Dissolved Oxygen
EAA	Everglades Agricultural Area
ECP	Everglades Construction Project
EMC	Event Mean Concentration
EPA	Everglades Protection Area
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FWMC	Flow-weighted mean concentration
HUC	Hydrologic Unit Code
LA	Load Allocation
Lb/day	pounds per day
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer Systems
mt	metric ton
NPDES	National Pollutant Discharge Elimination System
OFW	Outstanding Florida Water
PLOAD	Phosphorus Load model
PLR	phosphorus loading rate
PLRG	Pollutant Load Reduction Goal
ppb	parts per billion (micrograms per liter)
R-EMAP	Regional Environmental Monitoring and Assessment Project
SFER	South Florida Environmental Report
SFWMD	South Florida Water Management District
SSAC	Site-Specific Alternative Criterion
STA	Stormwater Treatment Area
TBEL	Technology-based Effluent Limit
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
USEPA	United States Environmental Protection Agency
WBID	Water Body Identification
WCA	Water Conservation Area
WLA	Wasteload allocation
WMD	Water Management District
WQBEL	Water Quality Based Effluent Limit
WY	Water Year (May to April)

SUMMARY SHEET

1. Florida 1998 303(d) Listed Waterbody Information

WBID	Segment Name	Classification	Constituent	County	HUC
3265B* (3265F, 3265H)	Everglades Water Conservation Area 2A Southwest Perimeter	3F	Nutrients, DO, Fecal Coliform**, Cadmium**	Broward, Palm Beach	03090202
3252B	Everglades Water Conservation Area 1 North Sector (Arthur R. Marshall Loxahatchee National Wildlife Refuge	3F	Nutrients, DO, Fecal Coliform**, Total Suspended Solids**	Palm Beach	03090202
3263	S-7 Basin	3F	Nutrients, DO, Turbidity**	Palm Beach	03090202
3260	S-8 Basin	3F	Nutrients, DO	Palm Beach, Hendry	03090202
3252A	Knight's Farm Field 1	3F	Nutrients	Palm Beach	03090202
3252C	ACME North Sector (formerly Knight's Farm Field 3)	3F	Nutrients	Palm Beach	03090202

* This WBID is included on the 1998 303(d) list and the 1998 Consent Decree. It was redrawn and renamed by FDEP in 2006. New names are in parentheses.

** EPA has determined that TMDLs are not needed for these constituents, as water quality standards are currently achieved in the waterbody.

2. Water Quality Standards:

Class III: Waters. Recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. Class IV Waters: Agricultural water supply.

Dissolved Oxygen

Applies to Class III canals within the Everglades Agricultural Area (EAA) and Everglades:
DO (62-302.530(31)): Shall not be less than 5.0 mg/l. Normal daily and seasonal fluctuations above these levels shall be maintained.
Applies to the marsh throughout the Everglades Protection Area (EPA):
DO Site Specific Alternative Criterion (SSAC):
DO concentration can vary with water temperature and time of day to reflect natural diurnal biological processes.
Applies to Class IV canals within the EAA:
DO (62-302.530(31)): Shall not average less than 4.0 mg/l in a 24-hour period and shall never be less than 3.0. Normal daily and seasonal fluctuations above these levels shall be maintained.

Nutrients

Applies to Class IV canals within the EAA and Class III waters:
Nutrients (62-302.530(48)(a)): The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards contained in this chapter. Man induced nutrient enrichment (total nitrogen and total phosphorus) shall be considered degradation in

relation to the provisions of Section 62-302.300, 62-302.700, and 62-4.242, FAC.
Applies to Class III canals of the EAA and the EPA:
62-302.530(48)(b) In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna.
Applies to the marsh throughout the Everglades Protection Area.
The TP criterion is a long-term geometric mean of 10 ppb, as specified in Section 62-302.540, FAC.

Natural Conditions (62-302.200(15))**:** Florida's water quality standards provide a definition of natural background:

"Natural Background" shall mean the condition of waters in the absence of man-induced alterations based on the best scientific information available to the Department. The establishment of natural background for an altered waterbody may be based upon a similar unaltered waterbody or on historical pre-alteration data.

Florida's water quality standards (62-302.300(15)) also provide that:

Pollution which causes or contributes to new violations of water quality standards or to continuation of existing violations is harmful to the waters of this State and shall not be allowed. Waters having water quality below the criteria established for them shall be protected and enhanced. However, the Department shall not strive to abate natural conditions.

3. TMDL Targets

Nutrients: The TMDLs target Total Phosphorus (TP) because TP is the limiting nutrient for the Everglades. For the Everglades Protection Area WBIDs, the numeric TP criterion of 10 ppb geometric long-term average is applied at inflows as the equivalent annual maximum flow-weighted discharge limit of 16 ppb. For Everglades Agricultural Area (EAA) WBIDs, a TP concentration target is derived that is necessary to protect the downstream waters of the Everglades. This 100 ppb target is determined to be the concentration required at Stormwater Treatment Area (STA) inflows in order to result in the STA outflow of 16 ppb. The 100 ppb requirement is applied to Class III canals within the EAA. In addition, in order to protect Class III waters, this 100 ppb TP requirement is applied within the EAA to Class IV agricultural pumps at the point of discharge into Class III waters. The 100 ppb-based TMDL within the EAA should protect the designated use of the Class III canals within the EAA as well as diminish the contribution to water quality impairments in the downstream waters of the Everglades.

Dissolved Oxygen: TMDLs for dissolved oxygen are addressed through controlling nutrients. All of the water conveyances within the EAA are artificial canals that were constructed for flood control and water supply purposes. Due to groundwater influence, it may not be possible to consistently meet the present statewide DO standard for Class IV waters (not less than 3.0 mg/L and 24-hour average not less than 4.0 mg/L), even after controlling pollutant loadings to those waters. For the Everglades marsh, improvement in phosphorus condition such that the waterbody no longer is impaired for nutrients should result in attainment of the DO SSAC.

4. TMDL allocation for Total Phosphorus

WBID	Water Class	TMDL[1,2,3] (ppb)	WLA (ppb)	LA (ppb)[2,3]	MOS	Percent Reduction[4]
Everglades Agricultural Area or ACME Improvement District						
3263 (S-7)	Class III	100	0	100	Implicit	0%
	Class IV	100	0	100 (at inflow to Class III canal)	Implicit	0%
3260 (S-8)	Class III	100	0	100	Implicit	0%
	Class IV	100	0	100 (at inflow to Class III canal)	Implicit	0%
3252A (Knight's Farm Field 1)	Class III	100	0	100	Implicit	41%
	Class IV	100	0	100 (at inflow to Class III canal)	Implicit	41%
3252C (ACME North Sector)	Class III	100	0	100	Implicit	13%
Everglades Protection Area						
3265B (3265F, 3265H; WCA2A Southwest Sector)	Class III	16	(see note 5)	16	Implicit	56%
3252B (Refuge North Sector)	Class III	16	(see note 5)	16	Implicit	82%

Notes:

1. TMDL expressed as an annual load is calculated by multiplying 16 ppb times the annual flow and conversion factors. To express the TMDL as a daily load, the annual load is divided by 365 days per year.

2. 100 ppb based on STA inflow need of 100 ppb to meet STA effluent of 16 ppb annual maximum.

3. Allocation given to Class IV canals is necessary to protect the downstream Class III waters and should be implemented and monitored at the point of entry into Class III waters.

4. Based on WY2002-2006 annual averages.

5. Assumes all flow into this WBID is treated by STAs with NPDES permits. TMDL is to be applied on an annual basis by multiplying 16 ppb times the annual flow and conversion factors.

5. Endangered Species (yes or blank): Yes

6. **USEPA Lead on TMDL** (USEPA or blank): USEPA

7. **TMDL Considers Point Source, Nonpoint Source, or both**: Both

8. **Major NPDES Discharges to EPA WBIDs**

Facility	NPDES Permit	Impacted WBID	TP (ppb)
STA-1E	FL0304549	3252B	16 applied at all inflows to WBID
STA-1W	FL0177962-001	3252B	
STA-2	FL0177946-001	3265B	16 applied at all inflows to WBID
STA-3/4	FL0300195-001	3265B	

9. **MS4 Allocation. MS4 Permitees in the Drainage Basins of Impaired WBIDs**

County	Permitee	Permit ID Number	MS4 Type	TP target (ppb)
Palm Beach	Village of Wellington	FLS000018	Phase I	100

Note: The MS4 is responsible for controlling pollutant loads from the urban areas within its jurisdiction.

1 INTRODUCTION

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. Listed waters are prioritized with respect to designated use classifications and the severity of pollution. In accordance with this prioritization, states are required to develop Total Maximum Daily Loads (TMDLs) for those water bodies that are not meeting water quality standards. The TMDL process establishes the allowable loadings of pollutants for a waterbody based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water quality based controls to reduce pollution from both point and non-point sources and restore and maintain the quality of their water resources (United States Environmental Protection Agency [USEPA], 1991). The TMDLs described in this report are being proposed pursuant to USEPA commitments in the 1998 Consent Decree in the Florida TMDL lawsuit (Florida Wildlife Federation, et al. v. Carol Browner, et al., Civil Action No. 4: 98CV356-WS, 1998).

The Florida Department of Environmental Protection (FDEP) developed a statewide, watershed-based approach to water resource management. Under the watershed management approach, water resources are managed on the basis of natural boundaries, such as river basins, rather than political boundaries. The state's 52 basins are divided into 5 groups. Water quality is assessed in each group on a rotating five-year cycle. The Everglades Basin is located in group 5. FDEP established five water management districts (WMD) responsible for managing groundwater and surface water supplies in the counties encompassing the districts. Waters within the Everglades region that are addressed in this TMDL report are managed through the South Florida Water Management District (SFWMD).

For the purpose of planning and management, the WMDs divided the districts into planning units defined as either an individual primary tributary basin or a group of adjacent primary tributary basins with similar characteristics. These planning units contain smaller, hydrological based units called drainage basins, which are further divided into "water segments". Each segment is assigned a unique Waterbody IDentification (WBID) number. A water segment usually contains only one unique waterbody type (lake, canal, etc.).

The locations of WBIDs in the Everglades are shown in Figure 1. The WBIDs that have nutrient TMDLs due September 30, 2007 as required by the Consent Decree are shown in Figure 2. This TMDL report addresses only those Everglades TMDLs that are due by September 30, 2007.

The TMDLs are based on current available information. These TMDLs can be revised in the future, as the science and knowledge of the Everglades ecosystem improves. Any significant changes to the TMDLs will be required to go through the public process.

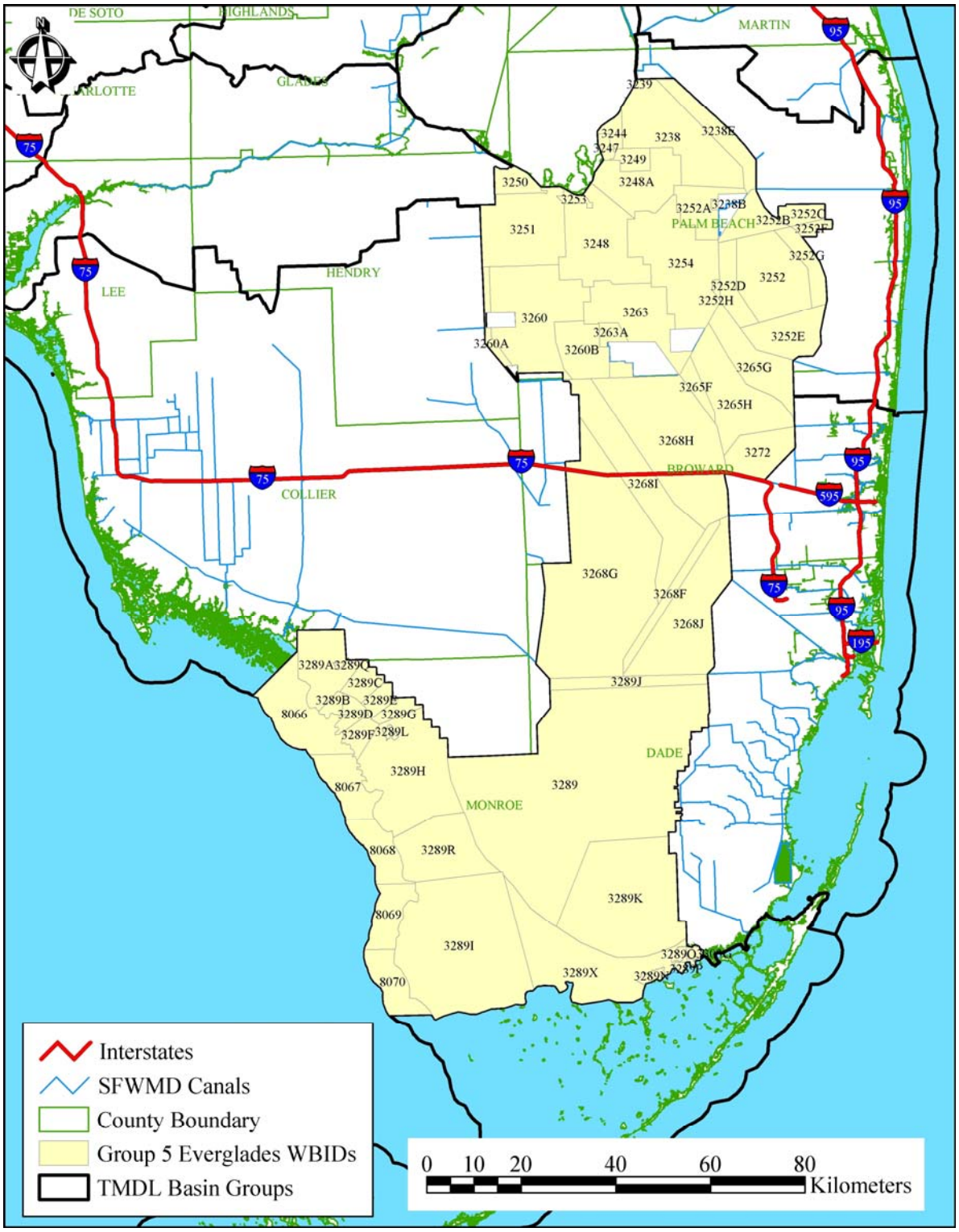


Figure 1. Location of Everglades WBIDs (from SFWMD and FDEP, 2007).

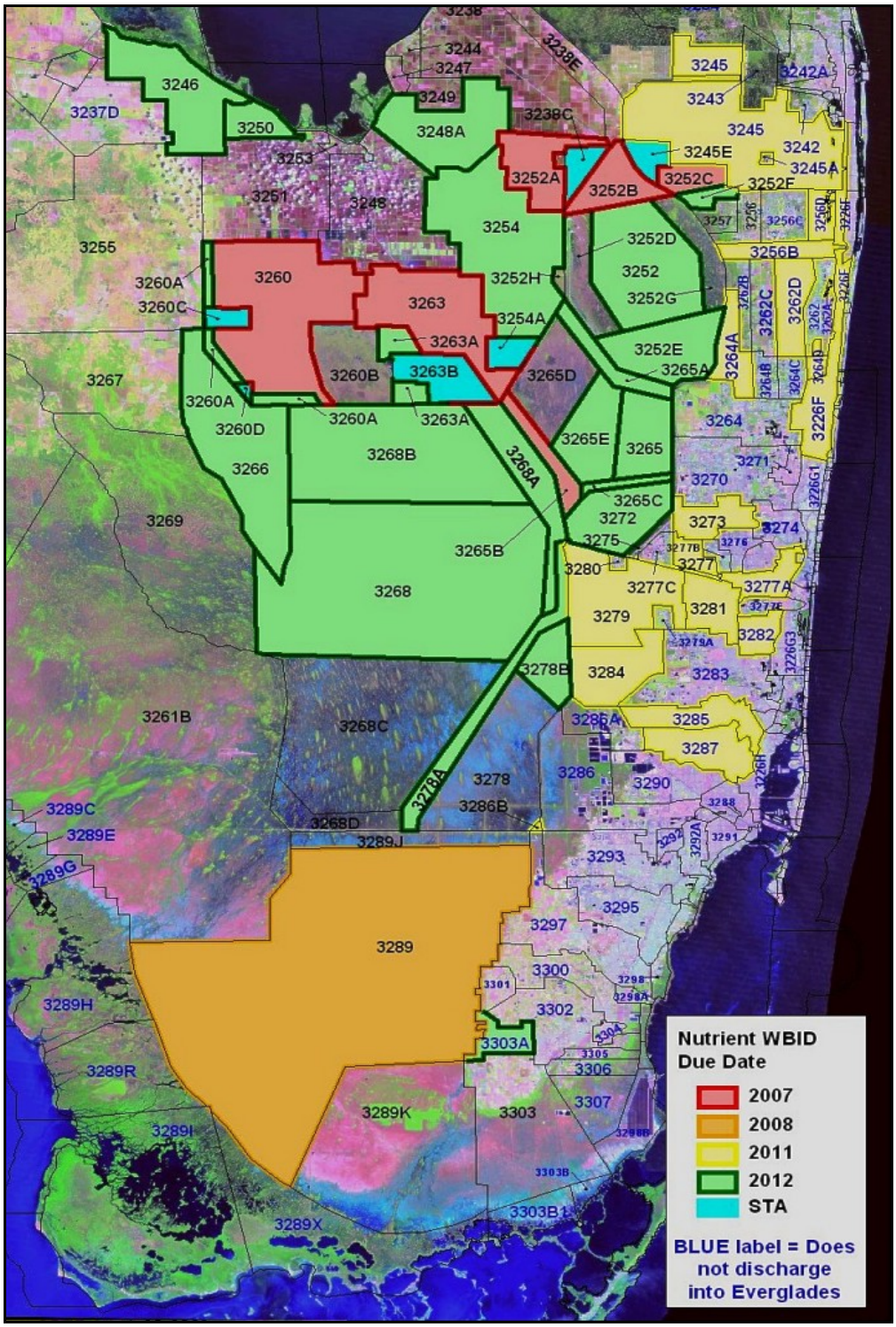


Figure 2. Due dates required in the 1998 Consent Decree for nutrient TMDLs in the Everglades.

1.1 Purpose of Report

This document presents TMDLs for pollutants contributing to 1998 listed impairments (nutrients and Dissolved Oxygen (DO)) in the Everglades Protection Area (EPA) or the Everglades Agricultural Area (EAA). These areas were identified by FDEP in 1998 as impaired by nutrients or DO. In 2005 FDEP revisited the impairment issue and again determined in their draft verified list that these areas are impaired for nutrients and DO (see Table 1). Because phosphorus is the limiting nutrient in the Everglades, it is the nutrient targeted in these TMDLs. Pollutant load reductions to Total Phosphorus (TP) should result in reduced nutrient loadings and ultimately achieve the designated use and not contribute to waterbody impairment.

Table 1. Planning Unit and Basin Group for Impaired WBIDs

WBID	Segment Name	Planning Unit	Basin Group
3265B* (3265F, 3265H)	Everglades Water Conservation Area 2A Southwest Perimeter	Everglades Water Conservation Area 2	5
3252B	Everglades Water Conservation Area 1 North Sector (Arthur R. Marshall Loxahatchee National Wildlife Refuge)	Everglades Water Conservation Area 1	5
3263	S-7 Basin	Everglades Agricultural Area	5
3260	S-8 Basin	Everglades Agricultural Area	5
3252A	Knight's Farm Field 1	Everglades Agricultural Area	5
3252C*	ACME North Sector (formerly Knights Farm Field 3)	Everglades Water Conservation Area 1	5

* This WBID is included on the 1998 303(d) list and the Consent Decree. It was redrawn and renamed by FDEP in 2006. New names are in parentheses.

1.2 Identification of Impaired Waterbodies

1.2.1 Everglades Agricultural Area

The EAA is located on the southern tip of Lake Okeechobee and is one of the most productive agricultural regions in the State. Over 505,000 acres of the EAA are under production with sugar cane that accounts for over 80 percent of total crop coverage. Farmers also grow vegetables, sod, and rice during the winter months. Several major public canals (Miami, West Palm Beach, Hillsboro, and North New River) had been built by the 1920's to drain and irrigate the EAA. These canals underwent major renovations and became part of the Central and Southern Florida Project (C&SF Project). These canals are Class III waters (see section 3). They are included on the 1998 303(d) list as impaired for nutrients and DO.

Florida's 1994 Everglades Forever Act (EFA) required EAA landowners to reduce the total phosphorus in the runoff from their land by 25 percent basin-wide (Rule 40E-63). The green labels in Figures 3, 4, 6 and 8 identify the specific farm basins permitted to discharge under this rule. Landowners are implementing Best Management Practices (BMPs) to manage water, sediments, and nutrients that balance water quality improvements and agricultural productivity. From water year 1996 to 2006 EAA Basin reductions were better than the 25% annual reduction required by the EFA.

There are three WBIDs in the EAA that are included on the 1998 303(d) list as impaired for nutrients and DO that have TMDLs due by September, 30, 2007 as required by the 1998 Consent Decree: WBID 3260 (S-8 Basin); 3263 (S-7 Basin); and 3252A (Knight's Farm Field 1) (Figures 2 and 3). Land cover for all of these WBIDs is predominately agriculture (Table 2). All of these WBIDs drain into Stormwater Treatment Areas (STAs, wetlands constructed and managed to remove phosphorus from stormwater) which discharge into the downstream Everglades Protection Area (EPA). The EAA WBID delineations were drawn by FDEP in the 1980s. They do not accurately reflect current farm basins or drainages (Figures 3 to 9).

Figure 3. Location of WBIDs within the EAA (from SFWMD). WBIDs outlined in orange are the subject of this report. Black lines delineate farm basins. Green labels indicate permits under Florida EAA BMP Rule (Chapter 40E-63 F.A.C.).

1.2.1.1 WBID 3263

WBID 3263 (S-7 basin**)** is in Palm Beach County within the EAA and is about 51,480 acres in area (Figures 4 and 5). There are three C & SF Project canals in the basin: the North New River Canal, the L-6 borrow canal and the L-5 borrow canal. The North New River Canal connects Lake Okeechobee to Everglades Water Conservation Areas (WCAs) 2 and 3. The connection to WCA2 is by the S-7 pump station, and the connection to WCA3 is by the S-150 pump. Project control structures that affect flow in the S-7 basin include S-7, S-2 (connects the North New River canal to Lake Okeechobee), S-150, and S-351 (a gated spillway on Lake Okeechobee) (Cooper 1989). Most of the farm discharges within this WBID are treated by STA 3/4 prior to discharge into the EPA. The discharges from about 1000 acres in the northeast corner are treated by STA 2, and the discharges from about 5800 acres in the southwest corner are discharged westward to the Miami Canal. Land cover in the S-7 basin is almost entirely agriculture (95%, Table 2). Water, wetlands and forest account for only about 2% of the land use. There are only 30 acres of urban or residential land. The basin also includes the future 8600 acre Compartment B STA expansion, projected for 2010. There are 12 private pumps that discharge stormwater from agricultural land into the North New River Canal (Figure 4). The North New River Canal is designated as Class III water (recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife), while the smaller canals in agricultural lands that have been constructed and managed by private interests are all Class IV canals (agricultural water supply). There are no NPDES permitted facilities within this WBID.

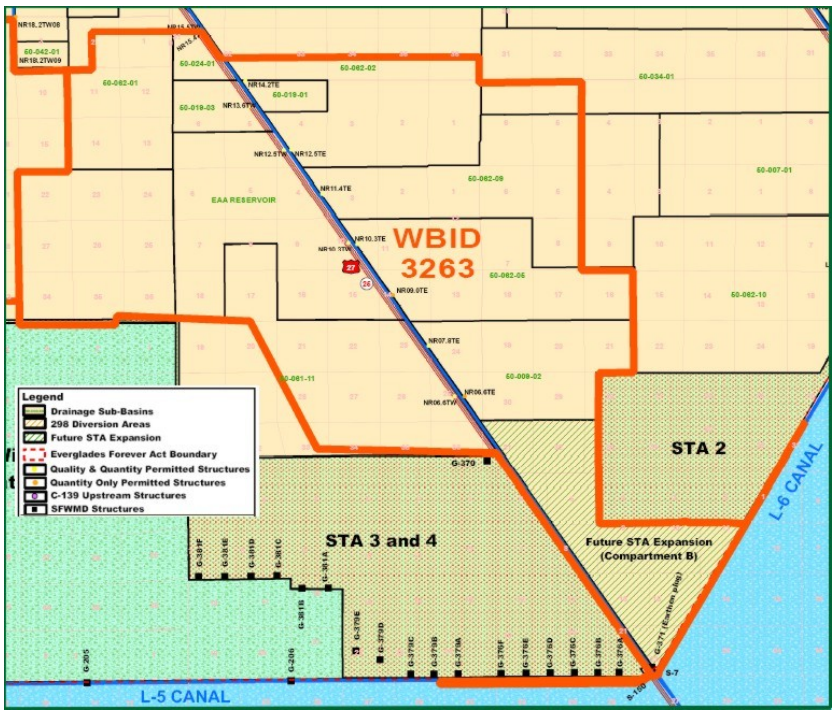


Figure 4. WBID 3263, S-7 basin (from SFWMD). Black lines delineate farm basins. Green labels indicate permits under Florida EAA BMP Rule (Chapter 40E-63 F.A.C.).

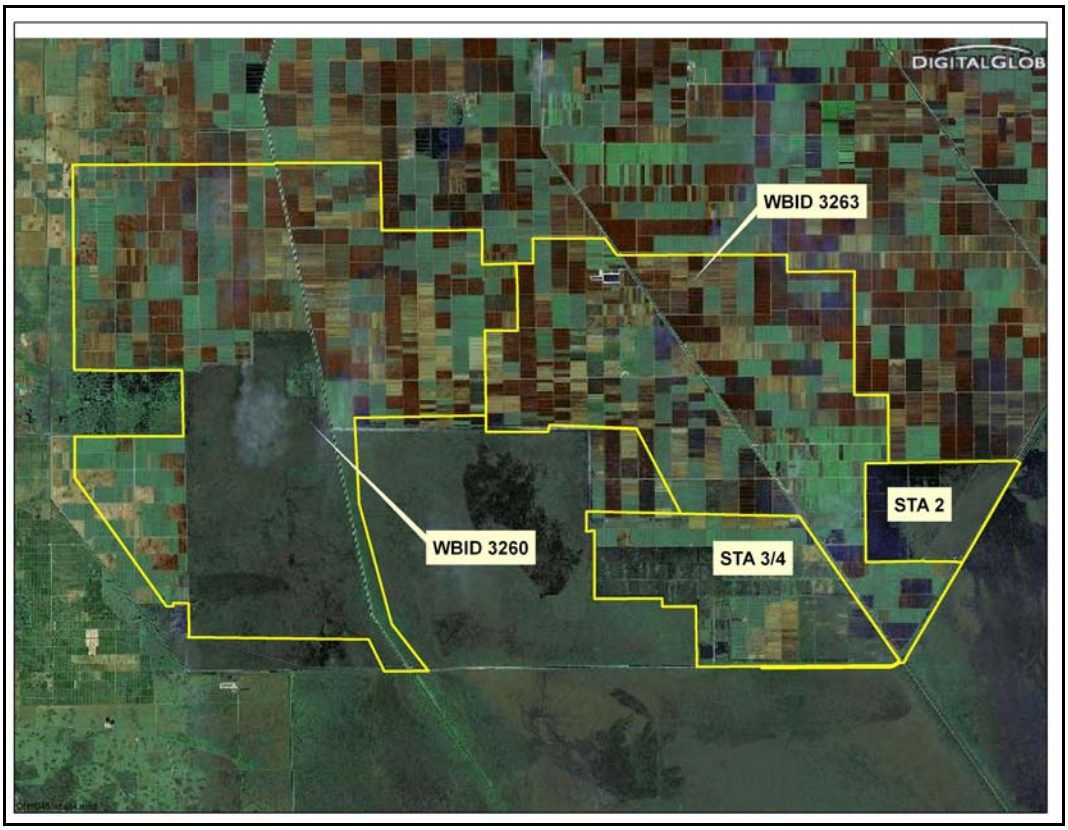


Figure 5. WBIDs 3260 and 3263 superimposed on 1999 satellite photo (copyright MDA EarthSat). Stormwater Treatment Areas 2 and 3/4 are also shown. The Everglades Protection Area is immediately to the south.

Table 2. Land use classification series for WBIDs. Data are for 1999.

WBID	Urban & Residential (1100-1390)	Commercial, Industrial, Public (1400, 1500, 1700, 1800,1900)	Agriculture (2000)	Rangeland (3000)	Forest (4000)	Water (5000)	Wetlands (6000)	Barren & Extractive (1600, 7000)	Transportation & Utilities (8000)	TOTAL (acres)
3252A	0	167	21,562	179	0	326	68	98	0	22,332
3252B	0	0	0	0	0	296	17,364	65	10	17,734
3252C	3,169	1,602	1,885	998	81	554	230	55	240	8,813
3260	0	0	55,787	29	0	344	27,047	709	8	83,924
3263	30	499	48,865	97	226	387	270	531	616	51,522
3265F	0	0	0	0	0	144	7,411	113	323	7,991
3265H	0	0	0	0	0	143	58,876	68	35	59,121

WBID	Urban & Residential (1100-1390)	Commercial, Industrial, Public (1400, 1500, 1700, 1800, 1900)	Agriculture (2000)	Rangeland (3000)	Forest (4000)	Water (5000)	Wetlands (6000)	Barren & Extractive (1600, 7000)	Transportation & Utilities (8000)	TOTAL (%)
3252A	0%	0%	97%	1%	0%	1%	0%	0%	0%	100%
3252B	0%	0%	0%	0%	0%	2%	98%	0%	0%	100%
3252C	36%	18%	21%	11%	1%	6%	3%	1%	3%	100%
3260	0%	0%	66%	0%	0%	0%	32%	1%	0%	100%
3263	0%	1%	95%	0%	0%	1%	1%	1%	1%	100%
3265F	0%	0%	0%	0%	0%	2%	93%	1%	4%	100%
3265H	0%	0%	0%	0%	0%	0%	100%	0%	0%	100%

1.2.1.2 WBID 3260

WBID 3260 (S-8 basin) encompasses 84,431 acres within the EAA and is located in Hendry and Palm Beach Counties (Figures 5 and 6). There are two C&SF Project canals in the basin: the Miami Canal and the L-4 Borrow Canal. The Miami Canal connects Lake Okeechobee to Everglades WCA 3A. The connection to WCA 3A is by the S-8 pump station, and the connection to Lake Okeechobee is by the S-3 pump. Project control structures that affect flow in the S-8 basin include S-3, S-8, S-354 (a gated spillway on Lake Okeechobee), and G-88 (a culvert at the intersection of L-3 and L-4 in northwestern WCA3A) (Cooper 1989). Stormwater from this WBID is treated in STA3/4 prior to discharge into the EPA. Land cover in the S-8 basin is primarily agriculture (66%, Table 2), although the basin also includes the Rotenberger Wildlife Management Area (a portion of Everglades managed by the State of Florida), and the future STA expansion (Compartment C, 8185 acres). These wetlands areas account for 32% of the basin. Several private pumps discharge stormwater from agricultural land toward or into the Miami Canal (Figure 6). The Miami and L-4 canals are designated as Class III waters, while smaller canals within the WBID are Class IV canals that drain agricultural lands. There are no NPDES permitted facilities within this WBID.

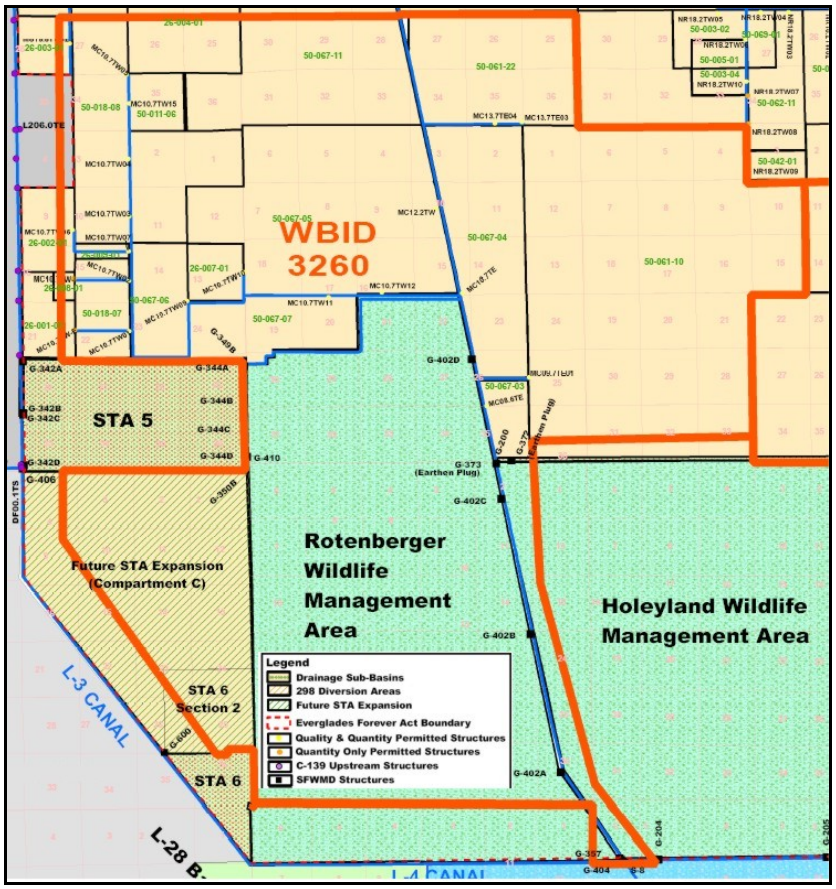


Figure 6. WBID 3260, S-8 basin (from SFWMD). Black lines delineate farm basins and green labels are permits under Florida EAA BMP Rule (Chapter 40E-63 F.A.C.).

1.2.1.3 WBID 3252A

WBID 3252A (Knight's Farm Field 1) is about 22,315 acres within the EAA adjacent to STA 1W (Figures 7 and 8). Stormwater from about 93% of this WBID is pumped to the southwest where it is treated in STA 2 prior to discharge into the EPA. Stormwater from about 7% of this WBID (the northeast portion) is discharged into STA1W for treatment prior to discharge into the Arthur R. Marshall Loxahatchee National Wildlife Refuge (the Refuge). Land cover in this WBID is almost entirely agriculture (97%, Table 2). There is no urban, residential, commercial or industrial land use. There are about 26 private pumps that discharge stormwater from agricultural land toward or into the Ocean Canal, a Class III water that is oriented east-west (Figure 8). The smaller canals in agricultural lands that have been constructed and managed by private interests are all Class IV canals. There are no NPDES permitted facilities within this WBID.

Figure 7. WBID 3252A superimposed on 1999 satellite photo (copyright MDA EarthSat). Stormwater Treatment Area 1W is also shown. The Arthur R. Marshall Loxahatchee National Wildlife Refuge is to the immediate east of STA 1W.

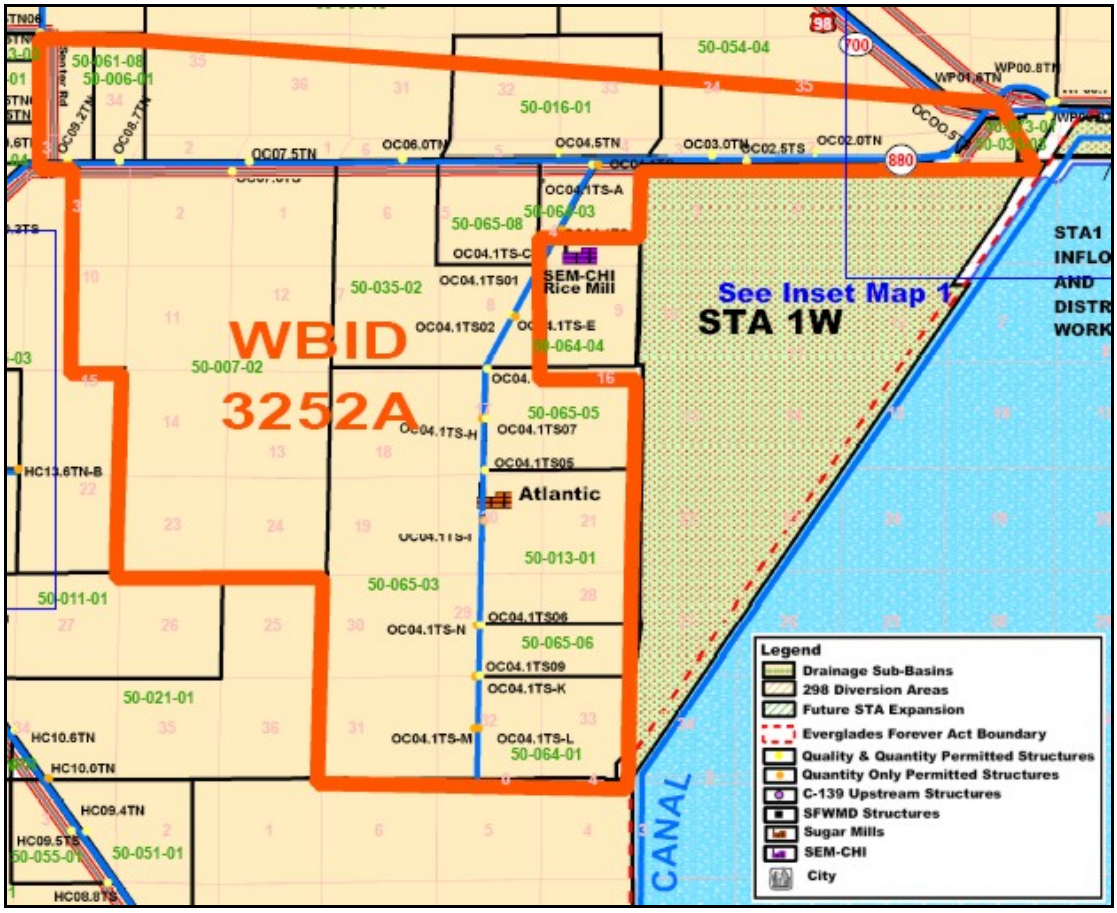


Figure 8. WBID 3252A, Knight's Farm Field 1 (from SFWMD). Black lines delineate farm basins. Green labels indicate permits under Florida EAA BMP Rule (Chapter 40E-63 F.A.C.).

1.2.1.4 WBID 3252C

WBID 3252C (ACME Basin North Sector) is about 8813 acres to the east of the Refuge. Land use in this WBID is a mix of primarily urban and residential (36%), agriculture (21%), and commercial and industrial (18%). Stormwater from this WBID is treated in STA 1E prior to discharge into the Refuge. This basin includes the Village of Wellington, which has a MS4 permit (FLS000018). There are no continuous discharge municipal or industrial NPDES permitted facilities within this WBID.

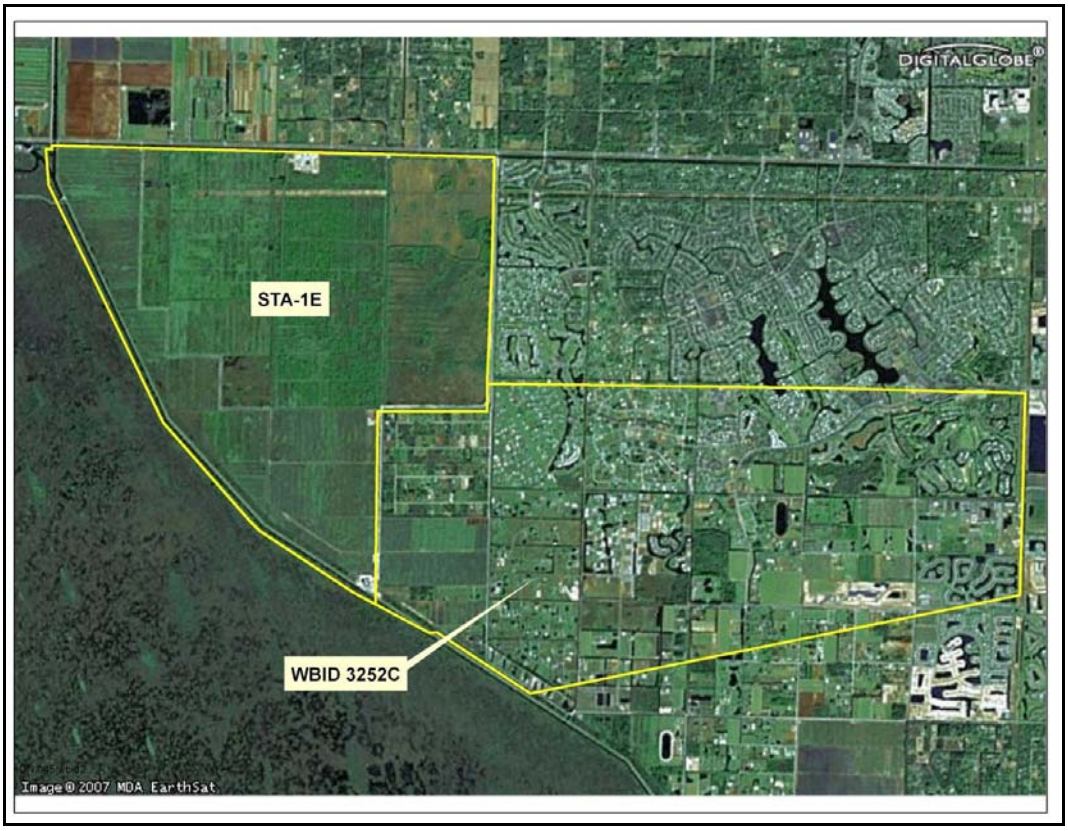


Figure 9. WBID 3252C superimposed on 1999 satellite photo (copyright MDA EarthSat). Stormwater Treatment Area 1E is also shown. The Arthur R. Marshall Loxahatchee National Wildlife Refuge is to the west.

1.2.2 Everglades Protection Area

The Everglades Protection Area (EPA) encompasses Everglades National Park, the Refuge (WCA1) and WCAs 2A, 2B, 3A and 3B. The EPA is a complex system of marsh areas, canals, levees, and inflow and outflow water control structures covering almost 2.5 million acres (Figure 10). The predominant source of inflow to the EPA is nonpoint source runoff resulting from rainfall. There are 13 basins that discharge water into the EPA.

1.2.2.1 WBID 3252B (WCA-1 North Sector)

WBID 3252B encompasses 17,772 acres of Everglades in the northern portion of the Arthur R. Marshall Loxahatchee National Wildlife Refuge. The National Wildlife Refuge is an Outstanding Florida Water, requiring that the quality of water that existed during the year prior to the 1979 designation be maintained. This WBID is 98% wetlands and 2% water. WBID 3252B receives treated surface water discharges from STA-1E via S362 and STA-1W via the G251 and G310 structures, respectively. STA-1E receives inflow from both the C-51 West and S-5A basins, while STA-1W receives inflow from the S-5A and L-8 basins. Additionally, untreated stormwater runoff

may be diverted around the STAs (via the G300 and G301 structures) into the Refuge. Annual flow, total phosphorus loads, and flow-weighted mean TP concentrations at structures discharging into the Refuge at WBID 3252B are summarized in Table 3 for the most recent five water years (WY2002-WY2006).

All water discharged into the Refuge in this WBID is to be treated by STA 1E or STA 1W. These STAs have NPDES permits (FL0304549 and FL0177962-001, respectively). The STA1W permit predates Florida's 2005 adoption of the 10 ppb numeric TP criterion for the Everglades, and as such it does not reflect current water quality standards, nor does it contain revised discharge limits. FDEP has stated that they intend to reissue this permit to reflect the 10 ppb criterion, with appropriate discharge limits. A wasteload allocation for these permits is included in this TMDL document.

Table 3. Water Year 2002-2006 Summary of Flows, TP Loads, and Average TP Concentrations into the Refuge at WBID 3252B (WCA-1 North Sector) (from SFWMD and FDEP, 2007).

Year	Parameter	G300+G301 untreated	G251 STA 1W outflow	G310 STA 1W outflow	S362 STA 1E outflow
WY 2002	Flow (1000 ac-ft)	11	7	261	
	TP Load (mt)	1.6	0.17	12.0	
	FWMC (ppb)	118.3	19.8	37.3	
WY 2003	Flow (1000 ac-ft)	10	97	499	
	TP Load (mt)	2.5	5.5	33.4	
	FWMC (ppb)	201.9	44.1	54.2	
WY 2004	Flow (1000 ac-ft)	17	55	243	
	TP Load (mt)	3.1	3.0	14.1	
	FWMC (ppb)	147.9	44.2	46.9	
WY 2005	Flow (1000 ac-ft)	69.1	62.85	320.5	15.9
	TP Load (mt)	27.0	7.8	38.7	7.6
	FWMC (ppb)	317.1	100.4	97.8	387.3
WY 2006	Flow (1000 ac-ft)	46.8	34.2	103.7	40.5
	TP Load (mt)	14.0	4.5	14.7	7.3
	FWMC (ppb)	242.5	107.4	115.1	145.7

FWMC = Flow-Weighted Mean Concentration. WY2002 = May 2001 to April 2002.

There was a marked increase in TP concentration in WY 2005 and 2006 in the untreated discharge from G-300 and G-301, as well as in the treated discharge from STA 1W. The increase in flows at the G300 + G301 diversion structures seen in WY 2005 and 2006 is due to decreased capacity in STA-1W due to hurricane damage which occurred in 2004 and STA enhancement construction activities. The decreased capacity in STA-1W, coupled with the partial capacity in the newly constructed STA-1E, resulted in the need for increased diversion at the G300 and G301 structures.

1.2.2.2 WBID 3265B (WCA-2A Southwest Perimeter)

WBID 3265B encompasses 11,201 acres of Everglades Water Conservation Area 2A (Figure 2). This WBID is entirely Everglades marsh or canals. During 2006 this WBID was subdivided into WBIDs 3265F and a small portion of 3265H (Figures 1 and 2, Appendix B). WBID 3265B receives surface water discharges from the S-7 structure and a portion of STA-2 (G335) via a 3,400 foot gap in the L-6 levee. Additionally, water may flow into 3265B through sheet flow from upstream areas of the unimpacted (unimpaired) WBID 3265D. STA-2 receives inflow waters from both the S-6 basin, WBID 3252A, and STA-1W conveyed via the L-7 canal. The S-7 structure discharges water from the S-7 basin including water treated by STA-3/4. Annual flow, total phosphorus loads, and flow-weighted mean TP concentrations at structures discharging to WBID 3265B are summarized in Table 3 for the most recent five water years (2002-2006). The summary for S7 was divided into pre- and post-STA 3/4 periods to account for the phosphorus removal provided by the STA after September 3, 2004. TP concentrations at S-7 improved after STA 3/4 began discharging.

All water discharged into WBID 3265B is to be treated by STA 2 or STA 3/4. These STAs have NPDES permits (FL0177946-001 and FL0300195, respectively). The STA 2 permit was issued in September of 2007. It includes the 10 ppb criterion and a technology-based effluent limit (TBEL) applied to the discharge that varies from 22 ppb to 39 ppb, depending upon the phosphorus loading rate (grams P per square meter of STA per year) to the STA and the number of flow-ways in operation (Goforth et al. 2007a). The present STA 3/4 permit predates Florida's adoption of the 10 ppb numeric TP criterion for the Everglades, and as such it does not reflect current water quality standards, nor does it contain revised discharge limits. FDEP has stated that they intend to reissue this permit to reflect the 10 ppb criterion, with appropriate discharge limits.

Table 4. Water Year 2002-2006 Summary of Flows, TP Loads, and Average TP Concentrations into EPA WBID 3265B (WCA-2 West Sector) (from SFWMD and FDEP, 2007).

Year	Parameter	G335* STA 2 outflow	S7 (pre 9/3/04)	S7 (post 9/3/04, from STA3/4)
WY 2002	Flow (1000 ac-ft) TP Load (mt) FWMC (ppb)	241 4.9 16.5	98 5.8 47.8	
WY 2003	Flow (1000 ac-ft) TP Load (mt) FWMC (ppb)	308 6.6 17.4	143 9.6 54.5	
WY 2004	Flow (1000 ac-ft) TP Load (mt) FWMC (ppb)	285 5.0 14.3	156 8.6 44.5	
WY 2005	Flow (1000 ac-ft) TP Load (mt) FWMC (ppb)	371 9.2 20.1	132.9 3.4 20.8	176.8 2.6 11.8
WY 2006	Flow (1000 ac-ft) TP Load (mt) FWMC (ppb)	322.3 8.2 20.7		456.7 10.8 19.2

*Only a portion of the water discharged from G335 immediately effects WBID 3265B; i.e., the portion of water that is conveyed to south.

2 STATEMENT OF WATER QUALITY PROBLEM

Section 303(d) of the Clean Water Act requires states to submit to the USEPA lists of waters that are not fully meeting their applicable water quality standards. FDEP has developed such lists, commonly referred to as § 303(d) lists, since 1992. As part of that process, FDEP included portions of the Everglades and the EAA on their 1998 § 303(d) list as impaired by excess nutrients or depressed dissolved oxygen. During 2006 FDEP revisited these determinations and found that the waters are still impaired (Appendices A and B).

About one-half of the 4000-square mile pre-drainage Everglades has been drained and converted to agricultural or urban land uses. The remaining components of the historical Everglades have been impacted by hydrologic alterations and by the introduction of excessive levels of nutrients, which have resulted in the ecological degradation of the system. The Everglades is naturally an oligotrophic ecosystem that evolved in response to low ambient concentrations of nutrients and seasonally fluctuating water levels. Prior to the creation of canals, nitrogen and phosphorus were primarily supplied to the Everglades in low concentrations in surface water sheet flow. The historical system was phosphorus limited, with ambient phosphorus concentrations in unimpacted areas generally less than 10 ppb at interior marsh sites.

The introduction of excess phosphorus to the Everglades has resulted in ecological changes over large areas of Everglades marsh. These changes are caused by cultural eutrophication, which is an increase in the supply of nutrients available in the marsh. The increase in nutrients has resulted in documented impacts to several trophic levels of aquatic life —including microbial, periphyton, macrophyte, invertebrate, and vertebrate communities—that constitute exceedances of the FDEP's Class III narrative nutrient criterion (Section 62-302.530, F.A.C.).

The excessive levels of phosphorus have also caused exceedances of the FDEP's Class III SSAC for DO in the EPA. Nutrient enrichment typically produces a variety of system changes that ultimately result in a depressed oxygen regime in the water column. The Everglades is a highly phosphorus limited system, and as phosphorus levels increase, productivity increases, as does the accumulation of organic matter in the water and sediments (i.e., increased biochemical oxygen demand [BOD] and sediment oxygen demand [SOD]). This increased demand for oxygen results in greater oxygen consumption in both the water column and sediments.

In addition to an altered community metabolism, changes in vegetation occur in response to eutrophication. As the degree (intensity or duration) of eutrophication increases, the open water slough communities are invaded by cattail (*Typha*) and other emergent vegetation (Rutchey and Vilchek, 1994; McCormick et al., 1999). The loss of the open water slough community and the shading (reduced light penetration) resulting from the increased growth of floating and emergent vegetation reduce the photosynthetic production of oxygen in the water column. Ultimately, the phosphorus enrichment results in an imbalance in the oxygen sources and sinks by increasing the demand for oxygen and reducing photosynthetic oxygen production. Therefore, the diel DO curves for phosphorus-enriched areas are characterized by overall lower DO levels and dampened diel

fluctuations (Weaver, 2004). Several segments of the EPA are identified on the FDEP's 2006 draft Verified List of Group 5 waterbodies as not meeting the Class III designated use due to nutrient impairment (Appendices A and B). Such impairment is based on technical evaluations performed by the FDEP, as set forth in numerous FDEP technical documents.[1]

2.1 Impaired Waterbody Segments

The impaired Everglades segments that have TMDLs due in 2007 are listed in Table 5 and shown in Figure 2. FDEP determinations for impairment are included in Appendices A and B, and are based on information reported on the 1998 303(d) list. Initial impairment determinations made by FDEP during 2006 for Group 5 waters are also shown. Phosphorus-impacted areas are based on water phosphorus and soil phosphorus. Florida's Everglades TP criterion rule defines impacted as where soil TP exceeds 500 milligrams TP per kilogram of soil. Cattail also can be an indicator of phosphorus enrichment (Appendix C).

Table 5. FDEP impairment determinations for Everglades WBIDs.

Segments (WBIDs)	Impaired for Nutrients		Impaired for DO	
	1998	2006 draft	1998	2006 draft
S-7 Basin (3263)	Yes	Not assessed	Yes	Yes
S-8 Basin (3260)	Yes	Not assessed	Yes	Potentially Impaired
Knight's Farm Field 1 (3252A)	Yes	Not assessed	No	Insufficient Data
ACME North Sector (3252C)	Yes	Not assessed	No	Yes
WCA-1 North Sector (3252B)	Yes	Yes	Yes	Insufficient Data
WCA-2 Southwest Perimeter (3265B)	Yes	Yes	Yes	Insufficient Data

2.2 Pollutants of Concern

Phosphorus is the limiting nutrient in the Everglades (McCormick et al. 1999, McCormick et al. 2002, Noe et al. 2001). Accordingly, the TMDLs proposed in this document target phosphorus. Nitrogen is another plant nutrient that can contribute to eutrophication. However, because the Everglades marsh is phosphorus-limited, nitrogen has not been a concern. There is no numeric water quality criterion for total nitrogen in the Everglades. EPA is unaware of any data indicating that nitrogen causes imbalances in flora or fauna in Class III canals within the EAA.

[1] Payne, Weaver, and Xue, 2006; Payne, Weaver, and Xue, 2007; Payne, Weaver, Goforth, and Piccone, 2005.

There are two EPA WBIDs and two EAA WBIDs that are also listed for DO. DO may be depressed by excess nutrients. It may also be depressed in canals due to groundwater influence. Attaining the appropriate levels of phosphorus is expected to result in the achievement of the DO SSAC for the Everglades marsh. Controlling phosphorus is expected to result in an improvement in DO within EAA canals to the extent that lowered DO is due to phosphorus pollution.

2.3 Source of Pollutants

The following discussion is adapted from SFWMD and FDEP (2007). The major source of nutrient pollutants to the Everglades is stormwater. The EPA is a complex system of marsh areas, canals, levees, and inflow and outflow water control structures covering almost 2.5 million acres (Figure 10). The predominant source of inflow to the EPA is nonpoint source runoff resulting from rainfall. The inflows are regulated by water control structures from agricultural tributaries, such as the EAA, that feed the EPA from the north. The EAA Basin is the largest tributary source to the EPA.

The EAA Basin covers approximately 700,000 acres south of Lake Okeechobee in eastern Hendry and western Palm Beach Counties. This area of highly productive agricultural land comprises rich organic peat or muck soils and is considered to be one of Florida's most important agricultural regions. Approximately 77 percent of the EAA is devoted to agricultural production. The major crops in the EAA include sugar cane, vegetables, and sod, with secondary crops in rice and citrus.

The EPA also receives nonpoint source runoff from predominantly urbanized areas to the east (Figure 10). At times it also receives surface water inflows originating from Lake Okeechobee to the north for water supply, flood control, saltwater intrusion control, and environmental purposes.

As part of the Everglades Construction Project (ECP), which was mandated by the Everglades Forever Act, the SFWMD constructed five Stormwater Treatment Areas (STA-1W, STA-2, STA-3/4, STA-5, and STA-6). As part of its federal partnership with the State of Florida, the U.S. Army Corps of Engineers constructed a sixth STA, STA-1E, which along with the other STAs, is operated and maintained by the SFWMD.

In conjunction with contributing basin BMPs, these STAs reduce phosphorus levels via naturally occurring biological processes prior to discharging into the Everglades. These facilities are considered point source discharges and, therefore, are regulated through NPDES permits, pursuant to 403.088 F.S. in addition to Everglades Forever Act permits which are issued pursuant to 373.4592, F.S.

The SFWMD owns and operates 39 water control structures discharging into, within, or from the EPA that are not included in the ECP. These structures, referred to as non-ECP structures, are operated and maintained for multiple purposes, including flood control, water supply, and the management of natural systems. Only 8 of the 39 water control structures discharge stormwater and other nonpoint source runoff from agricultural and urban areas into the EPA.

In conjunction with landowners, local governments, and other agencies, the SFWMD has developed water quality improvement strategies for each of the eight non-ECP basins that discharge into the

EPA. The first line of phosphorus control in these basins is through the implementation of BMPs at the source. In addition, many local and regional water resource projects are under way to further reduce TP loading into the EPA, including Critical Restoration Projects associated with the Comprehensive Everglades Restoration Plan and the Acceler8 Program. The Acceler8 program is a Florida initiative to accelerate specific Everglades restoration projects, including new or expanded STAs.

The timing and distribution of surface inflows from the tributaries to the EPA are based on a complex set of operational decisions that account for natural and environmental system requirements, aquifer recharge, flood control, and water supply for agriculture, urban areas and natural areas. Each year, the EPA receives variable amounts of surface water inflows based on rainfall and resulting hydrologic variability in the upstream basins. These inflows also contribute a certain amount of TP loading to the EPA system. In some cases, surface water inflows represent a mixture of water from several sources as the water passes from one area to another before finally arriving in the EPA. For example, water discharged from Lake Okeechobee can pass through the EAA and then through an STA before arriving in the EPA.

Some of the TP loading to the EPA is from atmospheric deposition. Annual average atmospheric deposition of TP ranges from 107 to 143 metric tons (mt) as the total contribution to the WCAs. Deposition rates are highly variable and very expensive to monitor and, as such, atmospheric inputs of TP are not routinely monitored. The range (20 to 35 milligrams per square meter per year [$mg/m^2/yr$]) is based on data obtained from long-term monitoring that was evaluated by the SFWMD, as reported in Redfield (2002).

The most common water quality problems in the Everglades are elevated levels of nutrients and low DO. TP levels are higher than statewide medians, and most of the DO observations fall below the 5.0 mg/l Class III water quality criterion. Many of the impaired waterbodies are canals. In constructed waterbodies it is difficult to consistently meet DO standards developed for natural water systems such as lakes and streams. In the EAA, the impaired waterbodies are canals where low DO concentrations occur naturally.

Figure 10. The Everglades Protection Area and tributary basins (from SFWMD and FDEP, 2007).

3 WATER QUALITY STANDARDS

Water quality criteria established by the State of Florida are described in the Florida Administrative Code (F.A.C.), Section 62-302.530. The individual criteria should be considered in conjunction with other provisions in water quality standards, including Section 62-302.500 F.A.C. [Surface Waters: Minimum Criteria, General Criteria] that apply to all waters unless alternative or more stringent criteria are specified in F.A.C. Section 62-302.530. In addition, the designated use and water quality of downstream waters must be maintained.

All waters of the EPA (wetland or canal) are designated as Class III: recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. In addition, the Refuge and Everglades National Park are both designated as Outstanding Florida Waters (OFWs), under Section 62-302.700, F.A.C. This non-degradation status requires that the quality of water that existed the year prior to the 1979 designation is maintained. Class IV waters are designated for agricultural water supply.

The WBIDs within the EAA include Class III canals as well as Class IV canals. FAC 62-302.400(12)(a): All secondary and tertiary canals wholly within agricultural areas are classified as Class IV and are not individually listed as exceptions to Class III. "Secondary and tertiary canals" shall mean any wholly artificial canal or ditch which is behind a control structure and which is part of a water control system that is connected to the works (set forth in Section 373.086, F.S.) of a water management district created under Section 373.069 F. S., and that is permitted by such a water management district pursuant to Section 373.414, or Section 373.416, F.S. Agricultural areas shall generally include actively used solely for the production of food and fiber which are zoned for agricultural use where county zoning is in effect.

FDEP has made no determination as to which canals within the EAA are Class III waters and which canals are Class IV waters. For purposes of this TMDL document, it is assumed that Class III canals within the EAA are those that are constructed by the U. S. Army Corps of Engineers or SFWMD that are part of the C & SF Project, and are maintained and operated by the SFWMD, or are considered Works of the District. Agricultural canals that have been constructed by and are operated by private interests are assumed to be Class IV canals with a designated use of agricultural water supply.

The Everglades BMP Regulatory Program for the EAA (Rule 40E-63, F.A.C.) requires that dischargers to the SFWMD's Works (canals) in the EAA basins obtain a permit for those discharges. Rule 40E-63 permits approve a BMP plan and a water quality monitoring plan for TP for each sub-basin or farm, as applicable. Currently, there are 33 EAA basin BMP permits, including approximately 205 sub-basins and 286 privately owned water control structures discharging into the SFWMD canals in the EAA. Most of the sub-basins have muck soils and highly managed drainage systems that use pumps. The areas represented by single permits vary substantially in size, from 120 to 92,000 acres. Each permit approves an on-site implementation plan for BMPs (BMP plan) in accordance with the EFA (Subparagraph 373.4592[4][f][2][c], F.S.), which states that permits issued under the Everglades Regulatory Program require BMPs for varying crops and soil types. The BMP

plan includes operational programs or physical enhancements designed to reduce phosphorus levels in water discharged to the SFWMD canals. As of 1996 the EAA basin as a whole was to have achieved a 25% TP load reduction in a given water year when compared to a pre-BMP baseline period of 1978 to 1988. The EAA met this requirement basin-wide from WY1996 to WY2007.

All farms within the EAA are subject to this BMP rule, and all structures discharging from these farms into the SFWMD's works (Class III canals) have permits. Monitoring of phosphorus and discharge is required at these private pumps. All canals and conveyances to the upstream side of these pumps are considered Class IV canals.

3.1 Nutrient Criteria

3.1.1 Nutrient Criteria for Class III Waters

The designated use of Class III waters is recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. FDEP has not adopted a numeric nutrient criterion for Class III canals within the EAA. Therefore, the Class III narrative criterion applies to these canals:

> Nutrients (62-302.530(48)(a)): The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards contained in this chapter. Man induced nutrient enrichment (total nitrogen and total phosphorus) shall be considered degradation in relation to the provisions of Section 62-302.300, 62-302.700, and 62-4.242, FAC.
>
> 62-302.530(48)(b) In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna

For the Everglades Protection Area, in 2005 Florida established and USEPA approved a numeric phosphorus criterion that has been determined through research to be protective of the natural populations of aquatic flora and fauna of the Everglades. The phosphorus criterion is a long-term geometric mean of 10 ppb, as specified in Section 62-302.540, F.A.C. This numeric criterion applied to the entire EPA.

3.1.2 Nutrient Criteria for Class IV Waters

The designated use of Class IV canals is agricultural water supply. FDEP has not adopted numeric nutrient criteria for Class IV canals within the EAA. Therefore, the following Class IV narrative criterion applies to canals within the EAA:

> Nutrients (62-302.530(48) (a)): The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards contained in this chapter. Man induced nutrient enrichment (total nitrogen and total phosphorus) shall be considered degradation in relation to the provisions of Section 62-302.300, 62-302.700, and 62-4.242, FAC.

3.2 Dissolved Oxygen Criteria

3.2.1 DO Criteria for Class IV Canals

The DO criterion that applies to Class IV canals within the EAA is as follows:

> DO (62-302.530(31)): Shall not average less than 4.0 mg/l in a 24-hour period and shall never be less than 3.0. Normal daily and seasonal fluctuations above these levels shall be maintained.

In applying the DO criterion in this TMDL, EPA also considered the definition of natural background and the directive not to abate natural conditions set out in Florida's water quality standards. See 62-302.200(15) FAC and 62-302.300(15) FAC.

3.2.2 DO Criteria for Class III Canals

The DO criterion that applies to Class III canals within the EAA and Everglades is as follows:

> DO (62-302.530(31)): Shall not be less than 5.0 mg/l. Normal daily and seasonal fluctuations above these levels shall be maintained.

The narrative nutrient criterion is also controlling as it relates to dissolved oxygen [62-302.530(48)(a)].

> The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards contained in this chapter.

3.2.3 DO Site Specific Alternative Criteria

The 1994 EFA directed FDEP and the SFWMD to evaluate existing water quality standards applicable to the EPA. As documented in the Everglades Consolidated and Interim Reports (1999–2003), DO concentrations in the macrophyte- and periphyton-dominated marshes of the Florida Everglades routinely fall below the state Class III water quality criterion (Section 62-302.530, F.A.C.) of 5.0 milligrams of oxygen per liter (mg O_2/L) on a daily basis and exhibit wide daily (diel) fluctuations due to the natural processes of photosynthesis and respiration. For example, in a pristine marsh community in the Park, with bladderwort and an extensive calcareous periphyton mat, the DO naturally fluctuated over 24 hours from 0.8 to 11.0 mg/L, and was < 5.0 mg/L for about 50% of the day (Scheidt et al.,1985).

In recognition of these naturally occurring fluctuations that do not meet the Class III DO criterion, the FDEP established a DO Site Specific Alternative Criterion (SSAC) for the marsh within the EPA; this SSAC was adopted by FDEP on January 26, 2004, and approved by the USEPA on June 16, 2004 as a revision to the Florida Water Quality Standards. Because a single-value criterion does not adequately account for the wide-ranging natural diel fluctuations observed in the marsh, the DO SSAC provides a mechanism to account for the major factors (time of day and temperature) influencing natural background DO variation in the Everglades.

FDEP identified marsh reference sites within WCA 2A based on TP and ecological conditions. Diel data were used to define a relationship between DO, time of day and water temperature. A predictive sinusoidal model was developed that defines the average DO regime at these reference sites. The model was cross-validated with a set of reference sites from other parts of the Everglades. The curve predicted by the model was then adjusted to account for natural temporal (seasonal and

annual) and spatial variability. Since the model defines the average condition, lower natural fluctuations would still be expected. Therefore, the model was adjusted so that the 10% lower rejection limit is used as the SSAC assessment limit. Compliance with the SSAC is based on a comparison between the annual average of multiple DO measurements made throughout the year, and the average of the corresponding DO values specified by the model (Weaver, 2004). The achievement of the Everglades DO SSAC is assessed annually, with the results reported in the South Florida Environmental Report (SFER) (Weaver et al., 2007).

3.2.4 Natural Conditions

Florida's water quality standards provide a definition of natural background:

> "Natural Background" shall mean the condition of waters in the absence of man-induced alterations based on the best scientific information available to the Department. The establishment of natural background for an altered waterbody may be based upon a similar unaltered waterbody or on historical pre-alteration data.

See 62-302.200(15), FAC.

Florida's water quality standards also provide that:

> Pollution which causes or contributes to new violations of water quality standards or to continuation of existing violations is harmful to the waters of this State and shall not be allowed. Waters having water quality below the criteria established for them shall be protected and enhanced. However, the Department shall not strive to abate natural conditions.

See 62-302.300(15) FAC.

4 TARGET IDENTIFICATION

TMDLs identify the maximum amount of a pollutant that can be added to a waterbody without exceeding water quality standards. Additionally, allocations in a TMDL must not result in, or contribute to, any violation of other water quality standards for the waterbody or water quality standards downstream.

4.1 Basis and Rationale For Phosphorus Targets

Numeric targets for this TMDL are required to provide for a level of nutrients that will ensure protection for aquatic life for Class III waters. Additionally, the allocations of TMDLs for waters within the EAA must not impact, but protect, downstream waters of the Everglades.

4.2 Phosphorus Target Development

4.2.1 Everglades Protection Area

Florida has adopted and USEPA has approved a long-term geometric mean TP criterion for the EPA of 10 ppb. This 10 ppb long-term geometric mean water quality criterion applies throughout the EPA. Walker (2005) determined that the ratio of the long-term flow-weighted mean to the long-term geometric mean across all STAs for 24 water years is 1.18, with a standard error 0.04. The criterion has been calculated to translate into an equivalent maximum annual flow-weighted concentration of approximately 16 ppb at discharges into the Everglades (Payne et al. 2005b, Walker 2005). Payne et al. (2005b) concluded that a TP effluent limit of 15.5 ppb expressed as a maximum annual flow-weighted mean is recommended for incorporation into permits for all discharges into the EPA to assure that the discharges do not cause or contribute to exceedances of the phosphorus criterion in the downstream marsh receiving waters. This target can be re-evaluated in the future as more data become available. Although the annual maximum limit has not been formally adopted by FDEP as a Water Quality Based Effluent Limit (WQBEL), at the present time it represents the direct translation of the long-term numeric criterion to the discharge such that all water delivered to the EPA would meet the numeric criterion with a level of confidence.

The 16 ppb annual maximum concentration limit is used as the basis for the TP TMDL for discharges to WBIDs within the EPA. This approach should assure that all waters delivered to the EPA at WBIDs 3252B and 3265B will meet the TP criterion. The TMDL is based on an annual maximum concentration-based discharge limit of 16 ppb that applies to all discharges into the EPA. The TMDL is applied in future years by multiplying 16 ppb TP times the annual discharge and conversion factors to determine the acceptable TP load limit for that year. For example, annual discharge into the Refuge between WY 2002 and WY2006 ranged from about 225,000 acre-feet to 606,000 acre-feet (see Appendix D). Multiplying the 16 ppb limit by each annual discharge results in an annual maximum TP load limit for these years ranging from 4.4 to 12.0 metric tons per year (mt/yr). Likewise, annual discharge into 3265B at S-7 between WY 2002 and WY2006 ranged from about 98,000 to 457,000 acre-feet (Appendix D). Multiplying the 16 ppb limit by each annual discharge results in an annual maximum TP load limit for these years ranging from 1.9 to 9.0 mt/yr.

4.2.2 Everglades Agricultural Area

Targets for TP in the EAA were derived from two independent approaches as described below.

4.2.2.1 Approach #1: Estimate STA inflow loads resulting in WQS in downstream waters

In order to meet the 10 ppb criterion and protect downstream waters of the EPA, STAs must discharge an annual maximum of 16 ppb. STA performance is a function of phosphorus loading rate (PLR), expressed as grams TP per acre of STA area per year (Kadlec 2006, Pietro et al., 2007, Goforth et al., 2007a-2007f). PLR was used as the basis for deriving the Technology Based Effluent Limits (TBELs) that are in the NPDES permits issued in September 2007 for STA 2 , STA 5 and STA 6 (Goforth et al., 2007a, 2007b, 2007c). As PLR increases, the projected STA discharge TP concentration also increases. Relationships also have been explored for TP concentration at STA inflow versus TP outflow concentration (Pietro et al., 2007). The best predictor of STA outflow TP concentration appears to be PLR. PLR and existing STA acreage can be used to calculate the corresponding TP inflow load to the STA that will allow attainment of the desired effluent limits (Table 7). The inflow TP load is the product of inflow concentration and flow.

Pietro et al. (2007) summarize annual STA performance across all STAs for the history of the program. From 1995 to 2006 the three years with the lowest STA outflow concentrations (1997, 19 ppb; 1998, 20 ppb and 1999, 19 ppb) had corresponding PLRs of 0.93, 0.82 and 0.75, and inflow TP concentrations of 98 ppb, 98 ppb, and 90 ppb, respectively (Table 6). Outflow TP for the other nine years ranged from 20 ppb to 44 ppb; PLR was always greater than 1.0, ranging from 1.26 to 3.51; and inflow TP concentrations were all greater than 100 ppb, ranging from 109 ppb to 147 ppb. The years with the performance closest to the 16 ppb discharge goal all had PLRs less than 1.0 $g/m^2/yr$ and inflow TP less than 100 ppb. This 100 ppb concentration is used as the initial STA inflow target concentration until such time that it is demonstrated that the STAs can attain the maximum annual flow-weighted concentration of 16 ppb discharge goal with a higher inflow concentration. This concentration of 100 ppb is applied as the TMDL basis for the Class III waters within the EAA that discharge into the STAs. The basis is the requirement that the STAs discharges meet water quality standards for downstream waters.

In addition, since Class IV agricultural waters must be of adequate quality to protect downstream waters, the 100 ppb TP requirement is also applied to the private pumps within the EAA WBIDs at the point that they discharge into the Class III canals. This 100 ppb requirement is not applied throughout the Class IV canals, but only at the point where they discharge into Class III canals.

Table 6. Years with the lowest annual STA outflow TP concentration across STAs from 1995 to 2006 (Pietro et al., 2007).

WY	PLR g/m2/yr	TP inflow flow-weighted mean (ppb)	TP outflow flow-weighted mean (ppb)
1997	0.93	98	19
1998	0.82	98	20
1999	0.75	90	19

A TMDL must be adequate to assure that the designated use of as waterbody will be restored. FDEP has determined that the Class III canals within the EAA WBIDs are impaired for nutrients, and the designated use of these waters is not being met. FDEP presently uses a TP screening concentration of 220 ppb to indicate potential impairment for waterbodies. Because the 100 ppb goal for Class III waters within the EAA is much less than the 220 ppb screening level, the 100 ppb goal should result in attainment of the designated use for these Class III canals. If in the future FDEP changes water quality standards within the EAA for canals, such as by changing the designated use or adopting a numeric TP criterion, then this draft TMDL goal can be revisited.

Review of the adopted TBELs for STA 2, STA 5 and STA 6 (Goforth et al. 2007a, 2007b and 2007c) and the draft TBELs for STA 2, STA 1W and STA 1E (Goforth et al. 2007c, 2007d and 2007e) also indicate that a PLR of 1.0 $g/m^2/yr$ or lower is necessary in order for the STA outflow concentration to approach 16 ppb. Kadlec (2006) notes that in order to achieve an STA effluent of less than 20 ppb, STA PLR less than 1.0 is necessary. For these reasons, this TMDL assumes an STA PLR of 1.0 or less as a requirement for attaining a maximum annual flow-weighted concentration of 16 ppb at STA outflows. This TMDL can be revised in the future if STA performance demonstrates that a higher PLR can in fact sustain a maximum annual flow-weighted STA discharge of 16 ppb.

For illustration purposes, existing STA treatment acreages are used to calculate the corresponding STA inflow TP load that would result in a PLR of 1.0 $g/m^2/yr$ as follows: PLR x STA acres x unit conversion factors (Table 7). It should be noted that the 18,000 acre expansion of STAs that is underway will result in higher acceptable STA TP inflow loads while simultaneously maintaining the 1.0 PLR objective.

Table 7. Annual STA inflow TP loads based on PLR of 1.0 g/m^2/year.

STA	Downstream Impaired WBID	Treatment Area WY2006 (acres)	Inflow TP Load (metric tons)
STA 1W	3252B	4181	17.0
STA 1E	3252B	4024	16.3
STA 2	3265B/F	6430	26.2
STA 3/4	3265B/F	14,253	58.0

4.2.2.2 Approach #2: Simple modeling approach

A simple modeling approach was used where disturbed land use was changed in the four WBIDs outside of the Everglades Protection Area (3260, 3263, 3252A and 3252C) to reflect natural conditions (forest and wetlands). A spreadsheet based on USEPA's Pollutant Load (PLOAD) model (USEPA, 2001) was used to develop TP and TN targets. The spreadsheet was used to calculate nonpoint source loadings for nutrients as the product of the water quality concentration and runoff volume associated with certain land use practices. For these four WBIDs TP target concentrations are based on undisturbed conditions. Land uses classified as urban, agriculture, pasture, commercial, industrial, extractive or barren were considered disturbed categories and were changed to wetlands. Runoff volumes were calculated using estimates of annual average rainfall and Event Mean Concentrations (EMCs) for the various land uses. Annual average rainfall for the EAA is about 50.2 inches. Event Mean Concentrations (EMCs) assumed for each land use type in Florida were selected from those compiled by Harper and Baker (2003). Model results from the four WBIDs indicate that the TP concentration for natural conditions was projected to be 82 ppb to 89 ppb, with an average concentration of 87 ppb (Appendix E).

This procedure is designed to estimate loading to the Class III canal. It does not contain any water quality dynamics or a link to aquatic life use support but assumes that aquatic life is supported under natural conditions. The utility of this tool is best used to predict background, or undisturbed, loading to the canal which is then used to estimate natural resulting concentrations. The 87 ppb average TP concentration is similar to the 100 ppb STA inflow requirement. Therefore, EPA is assuming that the 100 ppb STA inflow target will also protect the designated uses of the EAA canals.

4.3 DO Target

FDEP established a DO Site Specific Alternative Criterion (SSAC) for the marsh within the EPA to address the naturally occurring fluctuations in DO in the marsh that do not meet the Class III DO criterion of 5.0 mg/L. Therefore, the DO target for WBIDs within the EPA is the DO SSAC. EPA

anticipates that attainment of the 10 ppb long-term TP criterion in those portions of the Everglades marsh not attaining the DO SSAC (WBIDs 3252B and 3265B) will result in those WBIDs attaining the SSAC.

The DO target for the remainder of the Class III waters in the EPA and EAA is Florida's applicable water quality standard for DO of 5 mg/L. EPA notes, however, that it is likely that many of these waters will not attain the applicable water quality standard for DO, even if the nutrient loads established in this TMDL are met. All Everglades canals are artificial conveyances that are influenced by groundwater which contains very low DO concentrations. Even canals within the Everglades with extremely low TP concentrations, such as the Tamiami Canal at Everglades National Park, typically have natural DO concentrations that are less than the 5.0 mg/L Class III criterion, especially before noon. In canals that are not nutrient impaired, attainment of the TP criterion does not necessarily mean that the DO criterion will be met. EPA believes that the nutrient target for this TMDL, which is based on a consideration of natural levels of TP as well as the level of TP that can be delivered to STAs and still protect the downstream Everglades marshes, limits TP so that it does not exert a negative effect on DO, as required by Florida's narrative criterion for nutrients. See 62-302.530(48)(a), FAC. Limiting TP beyond this point is not expected to have any additional beneficial effect on DO. A revised DO criterion (SSAC) for canals that are not impaired by nutrients should be considered to recognize that DO is naturally low in these artificial waterbodies. FDEP is in the process of investigating revised DO criteria for canals.

The DO target for the Class IV canals in the EAA is Florida's applicable water quality standard: shall not average less than 4.0 mg/L in a 24-hour period and shall never be less than 3.0 mg/L. Similarly to the Class III canals, EPA does not expect the Class IV canals to attain the DO minimum of 3.0 mg/L at all times, even if the TP goal is met. For example, WBIDs 3260 and 3263 meet the 100 ppb TP goal, yet these waters are listed as impaired for DO. As set above regarding the Class III canals, EPA believes this TMDL limits TP so that it does not exert a negative effect on DO, as required by Florida's narrative criterion for nutrients. A revised criterion should be considered by FDEP that would recognize that DO is naturally low in these artificial waterbodies.

5 WATER QUALITY RESULTS

Current phosphorus conditions within the EAA are shown in Table 8. Summary data for each WBID are presented in two ways. The annual mean TP concentration for each farm discharge was summarized by WBID (see Appendix D and references). The overall arithmetic mean for the WBID was then calculated. In addition, the TP concentrations were also weighted by the acreage of each farm (area-weighted) in order to more accurately reflect overall loading conditions for the WBID. The arithmetic mean of annual discharge data For WY 2007 discharge TP concentrations by farm field post-BMP ranged from 23.5 ppb to 629 ppb (Van Horn and Pescatore 2007). During WY 2002 to WY2006 TP concentrations in the EAA WBIDs that are the subject of this TMDL document, weighted by farm acreage, averaged 63 ppb for the S-8 basin (WBID 3260), 94 ppb for the S-7 basin (WBID 3263) and 168 ppb for Knight's Farm Field 1 (WBID 3252A) (Appendix D).

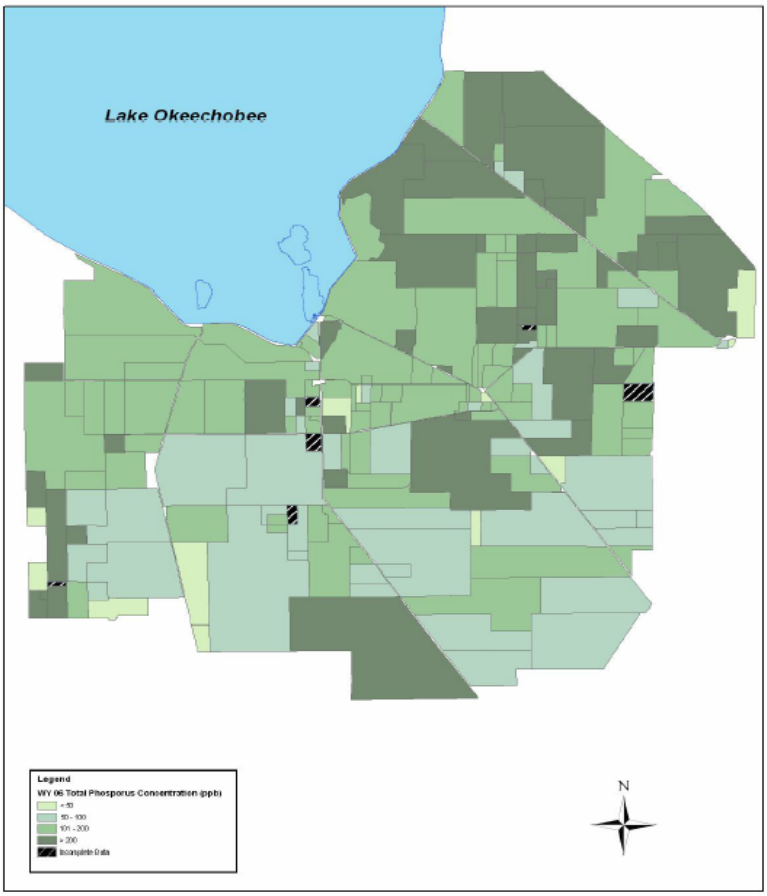


Figure 11. WY2006 flow-weighted mean TP concentrations in the EAA (Van Horn and Pescatore 2007).

For WY2002 to WY2006 the average TP concentration discharged into the Refuge (from STA-1W, STA-1E, G-300 and G-301) at WBID 3252B was 87 ppb, with an average annual load of 39 metric tons. For WY2002 to WY2006 the average TP concentration discharged into WBID 3265B at S-7 was 36 ppb, with an average annual load of 8 metric tons. It should be noted that once STA 3/4 came on line in 2004, TP concentrations at S-7 decreased (see Table 4). During WY2002-WY2004, TP load data for EAA farms were not reported.

Table 8. WY2002 to WY 2006 TP concentration and load for EAA and EPA WBIDs.

WBID	WY2002-WY2006 TP concentration (ppb) Area-weighted	WY2002-WY2006 TP concentration (ppb)	WY2002-WY2006 TP load (metric tons/year)
3263 S-7	93.8 ppb Post-BMP	89.9 ppb Post-BMP	45.0*
3260 S-8	62.7 ppb Post-BMP	91.9 ppb Post-BMP	35.2*
3252A Knights Farm Field 1	168.0 ppb Post-BMP	164.8 ppb Post-BMP	52.9*
3252C ACME North Sector	-	115.2 ppb	3.5
3265B WCA 2B	-	36 ppb into	8.2 into
3252B Refuge North Sector	-	87 ppb into	39.4 into

EAA farm data are from Sievers et al. 2003, McGinnes et al. 2004, McGinnes et al. 2005, Pescatore and Vega 2006, and Van Horn et al. 2007. ACME data are from Goforth et al. 2003, Piccone et al. 2004, Payne et al. 2005a, 2006, 2007.

* loads were only reported for WY2005-WY2006.

6 SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of source categories and the amount of pollutant loading contributed by these sources. Sources are broadly classified as either point or nonpoint sources. Phosphorus originating from atmospheric deposition is allocated to background loads. Several of the WBIDs are also impaired for DO. The sources contributing to nutrient impairment can also contribute to the low DO. Low DO concentrations in canals may also be attributed to groundwater influence due to channelization.

6.1 Background Loads

A certain amount of TP loading to the EPA is from atmospheric deposition. Annual average atmospheric deposition of TP ranges from 107 to 143 metric tons (mt) as the total contribution to the WCAs. Deposition rates are highly variable and very expensive to monitor and, as such, atmospheric inputs of TP are not routinely monitored. The range (20 to 35 milligrams per square meter per year [$mg/m^2/yr$]) is based on data obtained from long-term monitoring that was evaluated by the SFWMD, as reported in Redfield (2002).

6.2 Permitted Point Sources

A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Point source discharges of industrial wastewater and treated sanitary wastewater must be authorized by National Pollutant Discharge Elimination System (NPDES) permits. NPDES permitted facilities discharging treated stormwater are typically considered primary sources of nutrients. Waste Load Allocations (WLAs) are assigned to all NPDES permits discharging to surface waters.

6.2.1 Traditional Point Sources

Traditional point sources are defined as continuous release municipal or industrial wastewater NPDES permitted facilities. There are no traditional NPDES facilities discharging to surface waters in the impaired WBIDs.

6.2.2 Stormwater Treatment Areas (STAs)

Stormwater Treatment Areas (STAs) are large parcels of wetlands planted with specific species that act as filters to remove nutrients. The STAs remove phosphorus from agricultural stormwater runoff, facilitating restoration of downstream waterbodies. The four STAs discharging into EPA WBIDs 3252B and 3265B are subject to NPDES permit requirements (Table 9). For STA-2, interim period 1 applies when three STA flow-ways are in operation, and interim period 2 applies when four flow-ways are in operation (Goforth et al., 2007a)

Table 9. Permitted Facilities Discharging into impaired EPA WBIDs.

Name of Facility	Facility ID	WBID	Annual maximum TP limit (ppb)
STA-1E	FL0304549	3238E	68 *
STA-1W	FL0177962	3238C	68 *
STA-2	FL0177946	3254A	
Interim Period 1			30.4 -38.9
Interim Period 2			22.4 – 28.8
STA-3/4	FL0300195	3262B	68 *

* based on the initial 1994 goal of 50 ppb, not the new criterion of 10 ppb adopted in 2005. Applies only when the STA is in the post-stabilization operations phase.

6.2.3 Municipal Separate Storm Sewer System Permittees

Like other nonpoint sources of pollution, urban stormwater discharges are associated with land use and human activities, and are driven by rainfall and runoff processes leading to the intermittent discharge of pollutants in response to storms. The 1987 amendments to the Clean Water Act designated certain stormwater discharges from urbanized areas as point sources requiring NPDES stormwater permits. The three major components of the NPDES stormwater regulations are:

- Municipal Separate Storm Sewer Systems (or MS4) permits that are issued to entities that own and operate master stormwater systems, primarily local governments. Permittees are required to implement comprehensive stormwater management programs designed to reduce the discharge of pollutants from the MS4 to the maximum extent practicable.

- Stormwater Associated with Industrial Activities, which is regulated primarily by a multisector general permit that covers various types of industrial manufacturing facilities and requires the implementation of stormwater pollution prevention plans.

- Construction activity generic permits for projects that disturb one or more acres of land and which require the implementation of stormwater pollution prevention plans to provide for erosion and sediment control during construction and the treatment and management of stormwater to minimize pollution and flooding.

In October 2000, USEPA authorized FDEP to implement the NPDES stormwater program in all areas of Florida except Indian Tribal lands. FDEP's authority to administer the NPDES program is set forth in Section 403.0885, Florida Statutes. The Stormwater Rule was established as a technology-based program that relies on the implementation of BMPs that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, F.A.C.

The Stormwater Rule requires the state's water management districts (WMDs) to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a Surface Water

Management Plan, other watershed plan, or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL. To date, stormwater PLRGs have been established for Tampa Bay, Lake Thonotosassa, the Winter Haven Chain of Lakes, the Everglades, Lake Okeechobee, and Lake Apopka.

The NPDES stormwater program was implemented in phases, with Phase I MS4 areas including municipalities having a population above 100,000. Because the master drainage systems of most local governments in Florida are interconnected, EPA implemented Phase 1 of the MS4 permitting program on a countywide basis, which brings in all cities, Chapter 298 urban water control districts, and the Florida DOT throughout the fifteen counties meeting the population criteria. Phase II of the NPDES Program was expanded in 2003 and requires stormwater permits to construction sites between one and five acres, and to local governments with as few as 10,000 people.

Although MS4 discharges are technically referred to as "point sources" for the purpose of regulation, they are still diffuse sources of pollution that cannot be easily collected and treated by a central treatment facility. Most MS4 permits issued in Florida include a re-opener clause allowing permit revisions for implementing TMDLs once they are formally adopted by rule.

MS4 entities covering the drainage basins of the impaired WBIDs are shown in Table 10. The only MS4 permit is in WBID 3252C and is for the Village of Wellington. There are no urban areas in the WBIDs 3260, 3263 or 3252A of sufficient population to be covered by an MS4 permit. All future areas with populations meeting the MS4 requirements will be required to achieve the allocations presented in the TMDL.

Table 10. MS4 Permitees in the Drainage Basins of Impaired WBIDs.

County	Permit/Co-Permit Name	Permit ID Number	MS4 Type
Palm Beach	Village of Wellington	FLS000018	Phase II

6.3 Nonpoint Sources

Unlike traditional point source effluent loads, nonpoint source loads are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. These sources generally, but not always, involve accumulation of nutrients on land surfaces that wash off as a result of storm events. Nonpoint sources of phosphorus loadings in the Everglades watershed include agriculture, wildlife, and stormwater runoff. All non-point runoff that is delivered to the EPA passes through a water control structure, and is easily monitored for discharge volume and nutrient concentrations. A summary of anthropogenic nonpoint sources in the Everglades watershed is presented below.

6.3.1 Agriculture

Agricultural activities, which are the principle land uses in the impaired WBIDs, discharge large quantities of nutrients to the waterbodies through stormwater runoff.

Sugarcane has been grown commercially in the EAA since the 1920s and is one of the most economically important crops in the state. Sugarcane planting and harvesting operations are conducted during the fall and winter. During the summer wet months area farms store water by flooding vacant sugarcane fields or by growing paddy rice. Sugarcane is planted in rotation with rice, sod, spring and fall corn, and other assorted vegetables. To maximize the efficient use of plant nutrients in the soil, a rotation from higher to lower fertility requiring crops is normally practiced. Like any other plant, sugarcane requires nutrients for optimum growth. In the EAA, nutrients are provided from rainfall, irrigation water, organic soils, and fertilizer. Research studies based on yield responses have been used to establish guidelines currently used for fertilizer rates. Studies have shown that sugarcane biomass removes more phosphorus from the soil than the amount applied as fertilizer.

7 TMDL ALLOCATION

TMDLs identify the maximum amount of nutrients that can be added to a waterbody without exceeding water quality standards so as to protect the listed waterbodies and the downstream Everglades Protection Area.

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to attain the applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved.

7.1 Allocation

A TMDL can be expressed as the sum of all point source loads (Wasteload Allocations or WLA), nonpoint source loads (Load Allocations or LA), and an appropriate margin of safety (MOS), which accounts for uncertainty concerning the relationship between effluent limitations and water quality:

$$TMDL = \Sigma WLAs + \Sigma LAs + MOS$$

Federal regulations provide that TMDLs can be expressed in terms of mass per time (e.g. pounds per day), toxicity, or other appropriate measure (40 C.F.R.§ 130.2(i)). TMDLs for the EPA WBIDs are expressed as annual maximum flow-weighted TP concentration. Corresponding annual and daily loads are also presented for information purposes. However, attainment of the TMDL is based on the TP concentrations of 16 ppb (annual maximum) for waters discharged into the EPA and 100 ppb (annual average) within the EAA for waters discharged into Class III canals or the STAs. Annual flows in the Everglades fluctuate due to variation in annual rainfall. Flow will also vary over time as a series of new restoration activities are constructed and become operational (STA expansion, conveyance canals, water control structures, etc.) Strategies implemented in the watershed to achieve the TP TMDLs should also improve DO conditions to the extent that excess phosphorus is lowering DO.

The TMDL components are provided in Table 11 and are expressed as annual concentrations. The TMDL for EPA WBIDs is applied by multiplying 16 ppb times the annual flow and appropriate conversion factors. The target TP concentrations represent annual values and the TMDLs should be implemented to achieve the annual concentrations. An implicit Margin of Safety (MOS) is assumed in all of these TMDLs as described in Section 7.4. The percent reduction required to achieve water quality standards is calculated using the following equation:

$$\% \text{ Reduction} = (\text{existing load} - \text{TMDL}) / (\text{existing load}) * 100$$

7.2 Load Allocation (LA)

A LA is assigned to nonpoint sources in the watershed. For the EPA WBIDs, it is assumed that all

inflow is treated by STAs. Therefore, there are no nonpoint sources in the WBID and the entire TMDL is allocated to the Wasteload Allocation. Any water that does not pass through an STA before being discharged into these EPA WBIDs is still subject to the 16 ppb flow-weighted annual maximum requirement of this TMDL.

For the EAA WBIDs, there are no traditional NPDES facilities, MS4s or permitted STAs within these WBIDs. The entire TMDL is assigned to the Load Allocation. The TMDL was determined by reducing the WY2002 to WY 2006 TP loads and concentrations to meet the 100 ppb inflow target.

7.3 Wasteload Allocation (WLA)

For the EPA WBIDs it is assumed that all inflow is treated by STAs. Therefore the entire load into these WBIDs is assigned to the wasteload allocation. In future years the TMDL is applied by multiplying 16 ppb times the annual flow and appropriate conversion factors. The WLA is to be reflected in the NPDES permits for the appropriate STAs. All future point sources discharging to surface waters impacting the impaired WBIDs will be required to meet the 16 ppb requirement established in these TMDLs.

7.4 Margin of Safety

An implicit margin of safety for waterbody protection was provided in the TMDL analysis. The maximum annual flow-weighted TP concentration of 16 ppb is equivalent to the 10 ppb long-term geometric mean criterion for the Everglades marsh. This was based in part on STA performance data. This approach assumes that the same discharge limit can be applied to all STAs and inflows. Application of the TP criterion at the discharge point into the EPA assumes that there is no assimilative capacity in the receiving canals and marsh (i.e., any TP above the criterion would result in a phosphorus change that would be determined to be an imbalance). For the EAA WBIDs, the 100 ppb target was derived as what is necessary at STA inflows in order to protect downstream waters of the EFA. This 100 ppb target (applied to Class III canals within the EAA and Class IV discharges into Class III canals) is less than the 220 ppb screening level presently used by FDEP for TP impairment. This results in a margin of safety for protection of the designated use of these Class III waters within the EAA.

Table 11. TMDL allocation for Total Phosphorus

WBID	Water Class	TMDL[1,2,3] (ppb)	WLA (ppb)	LA (ppb)[2,3]	MOS	Percent Reduction[4]
Everglades Agricultural Area or ACME Improvement District						
3263 (S-7)	Class III	100	0	100	Implicit	0%
	Class IV	100	0	100 (at inflow to Class III canal)	Implicit	0%
3260 (S-8)	Class III	100	0	100	Implicit	0%
	Class IV	100	0	100 (at inflow to Class III canal)	Implicit	0%
3252A (Knight's Farm Field 1)	Class III	100	0	100	Implicit	41%
	Class IV	100	0	100 (at inflow to Class III canal)	Implicit	41%
3252C (ACME North Sector)	Class III	100	0	100	Implicit	13%
Everglades Protection Area						
3265B (3265F, 3265H; WCA2A Southwest Sector)	Class III	16	(see note 5)	16	Implicit	56%
3252B (Refuge North Sector)	Class III	16	(see note 5)	16	Implicit	82%

Notes:

1. TMDL expressed as an average annual load is calculated by multiplying 16 ppb times the annual flow and conversion factors. To express the TMDL as a daily load, the annual load is divided by 365 days per year.

2. Based on STA inflow need of 100 ppb to meet STA effluent of 16 ppb annual maximum.

3. Allocation given to Class IV canals necessary to protect the downstream Class III waters and should be implemented and monitored at the point of entry into Class III waters.

4. Based on WY2002-WY2006 data

5. Assumes all flow into this WBID is treated by STAs with NPDES permits.

7.5 Seasonal Variability

Seasonal variability was addressed in the selection of the nutrient target concentrations by considering data collected during all seasons. The data used for deriving the TP targets for the EPA and EAA include many years and seasons, various rainfall conditions, and several years of STA data. The data used to determine an acceptable TP loading rate and inflow for the STAs likewise capture over 10 years that include wet and dry conditions, various rainfall conditions, and drought and hurricanes.

8 TMDL IMPLEMENTATION

The Clean Water Act [Section 303(d)(2)] directs that a TMDL established by the Environmental Protection Agency be implemented by a State pursuant to subsection 303(e). A State can establish its own procedures for implementation. Federal regulations provide direction on implementation of TMDLs in the permitting process. At a minimum, NPDES permits must include a permit limit consistent with the assumptions of an approved wasteload allocation. Presently, STA 2 has an issued NPDES with such an initial TBEL permit limit. STA 1W, STA 1E, and STA3/4 do not have such permits.

Implementation of these TMDLs is the responsibility of Florida. Attainment of the TMDL may necessitate a variety of measures depending upon the basin and the existing quality of water. Florida has laid out such measures in their long-term plan for achieving water quality goals for tributary basins to the EPA. STA PLR is a function of STA size, inflow volume and inflow TP concentration. STA inflow concentration and flow can be affected by many factors including land use practices, agricultural BMP effectiveness and delivery of water from Lake Okeechobee. Decisions about how to attain these TMDL targets are left to the expertise of FDEP, SFWMD and private interests.

9 REFERENCES

Cooper, Richard M. 1989. An atlas of the Everglades Agricultural Area surface water management basins. South Florida Water Management District Technical Memorandum. West Palm Beach, Florida.

Florida Administrative Code (F.A.C.) 62-302.530. Criteria for Surface Water Quality Classifications.

Goforth, Gary, Tracey Piccone, Stuart Van Horn, Doug Pescatore and Cheol Mo. 2003. Chapter 8A: achieving long-term water quality goals. 2003 Everglades Consolidated Report. South Florida Water Management District. West Palm Beach, Florida.

Goforth, Gary, Nenad Iricanin, Steve Hill, Shi Kui Xue, Tracey Piccone, Frank Nearhoof and Ken Weaver. 2007a. Technical support document for the STA-2 TBEL. May 17, 2007.

Goforth, Gary, Nenad Iricanin, Steve Hill, Shi Kui Xue, Tracey Piccone, Frank Nearhoof and Ken Weaver. 2007b. Technical support document for the STA-5 TBEL. June 3, 2007.

Goforth, Gary, Nenad Iricanin, Steve Hill, Shi Kui Xue, Tracey Piccone, Frank Nearhoof and Ken Weaver. 2007c. Technical support document for the STA-6 TBEL. June 3, 2007.

Goforth, Gary, Nenad Iricanin, Steve Hill, Shi Kui Xue, Tracey Piccone, Frank Nearhoof and Ken Weaver. 2007d. Technical support document for the STA-1W TBEL. July 5, 2007.

Goforth, Gary, Nenad Iricanin, Steve Hill, Shi Kui Xue, Tracey Piccone, Frank Nearhoof and Ken Weaver. 2007e. Technical support document for the STA-1E TBEL. July 5, 2007.

Goforth, Gary, Nenad Iricanin, Steve Hill, Shi Kui Xue, Tracey Piccone, Frank Nearhoof and Ken Weaver. 2007f. Technical support document for the STA-3/4 TBEL. March 21, 2007.

Harper, H. H. and D. M. Baker. 2003. Evaluation of alternative stormwater regulations for southwest Florida. Environmental research and design, Inc.

Kadlec, Robert H. 2006. Free surface wetlands for phosphorus removal: the position of the Everglades Nutrient Removal Project. *Ecological Engineering* 27 (2006):361-379.

McCormick, Paul C., Susan Newman, ShiLi Miao, Ramesh Reddy, Dale Gawlik, Carl Fitz, Tom Fontaine and Darlene Marley. 1999. Ecological Needs of the Everglades. Chapter 3 in Everglades Consolidated Report. January 1, 1999. South Florida Water Management District.

McCormick, P. V., S. Newman, S. Miao, D. E. Gawlick, D. Marley, K. R. Reddy, T. D.

Fontaine. 2002. Effects of anthropogenic phosphorus inputs on the Everglades. pages 83-126 in J. W. Porter and K. G. Porter, eds. The Everglades, Florida Bay, and coral reefs of the Florida Keys: An ecosystem sourcebook. CRC Press LLC, Boca Raton, FL.

McGinnes, Paul, Doug Pescatore and Jose Vega. 2005. Appendix 3-1: Water year 2004 permit-level data. 2005 South Florida Environmental Report. South Florida Water Management District. West Palm Beach, Florida.

McGinnes, Paul, Doug Pescatore and Jose Vega. 2004. Appendix 3-1: Water year 2003 permit-level data. 2004 South Florida Environmental Report. South Florida Water Management District. West Palm Beach, Florida.

Noe, G. B., D. L. Childers, and R. D. Jones. 2001. Phosphorus biogeochemistry and the impact of phosphorus enrichment: Why is the Everglades so unique? *Ecosystems* 4:603-624.

Payne, Grover, Kenneth Weaver, Gary Goforth and Tracey Piccone. 2005a. Chapter 2C: status of phosphorus and nitrogen in the Everglades Protection Area. 2005 South Florida Environmental Report. South Florida Water Management District. West Palm Beach, Florida.

Payne, Garry, Kenneth Weaver and Frank Nearhoof. 2005b. Draft. Derivation of the water quality based effluent limit (WQBEL) for phosphorus discharges to the Everglades Protection Area. Florida Department of Environmental Protection. Tallahassee, Florida.

Payne, Grover, Kenneth Weaver and Shi Kui Xue. 2006. Chapter 2C: status of phosphorus and nitrogen in the Everglades Protection Area. 2006 South Florida Environmental Report. South Florida Water Management District. West Palm Beach, Florida

Payne, Grover, Kenneth Weaver and Shi Kui Xue. 2007. Chapter 3C: status of phosphorus and nitrogen in the Everglades Protection Area. 2007 South Florida Environmental Report. South Florida Water Management District. West Palm Beach, Florida

Pescatore, Doug and Jose Vega. 2006. Appendix 3-1a: Water year 2005 permit-level data. 2006 South Florida Environmental Report. South Florida Water Management District. West Palm Beach, Florida.

Piccone, Tracey, Gary Goforth, Stuart Van Horn, Doug Pescatore and Guy Germain. 2004. Chapter 8A: achieving long-term water quality goals. 2004 Everglades Consolidated Report. South Florida Water Management District. West Palm Beach, Florida.

Pietro, Kathleen, Ron Bearzotti, Michael Chimney, Guy Germain, Nenad Iricanin and Tracey Piccone. 2007. Chapter 5: STA performance, compliance and optimization. 2007 South Florida Environmental Report. South Florida Water Management District. West Palm Beach, Florida.

Redfield, G. 2002. Atmospheric deposition of phosphorus: concepts, constraints and published

deposition rates for ecosystem management. SFWMD (EMA) Report 403. South Florida Water Management District. West Palm Beach, Florida.

Rutchey, K., and L. Vilchek. 1994. Development of an Everglades map using SPOT image and global positioning system. *Photogrammetric Engineering and Remote Sensing.* 60:767-775.

Scheidt, Daniel J., David R. Walker, Ramona G. Rice and Mark D. Flora. 1985. Diel dissolved oxygen levels under experimental nutrient loading conditions in Shark Slough, Everglades National Park, Florida. *Florida Scientist* 48: supplement 1:36.

Scheidt, D. J. and P. I. Kalla. 2007. Everglades ecosystem assessment: water management, water quality, eutrophication, mercury contamination, soils and habitat. Monitoring for adaptive management: a R-EMAP status report. EPA 904-R-07-001. United States Environmental Protection Agency. Atlanta, Georgia.

Sievers, Pamela, Doug Pescatore, Jose Vega and Nancy Wilson. 2003. Appendix 3-1: Water year 2002 permit-level data. 2003 South Florida Environmental Report. South Florida Water Management District. West Palm Beach, Florida.

South Florida Water Management District and Florida Department of Environmental Protection. 2007. Reasonable assurances documentation for the Everglades Protection Area. Final. August 2007.

University of Florida. 2001. Florida water Resources. University of Florida Extension Institute of Food and Agricultural Sciences WQ101. Gainesville, Florida. April 2001.

USEPA, 1991. Guidance for Water-Quality Based Decisions: the TMDL Process. United States Environmental Protection Agency, Office of Water, Washington, DC EPA-440/4-91-001. April 1991. Washington, D. C.

USEPA, 2000. Nutrient Criteria Technical Guidance Manual, Rivers and Streams. United States Environmental Protection Agency, Office of Water, Washington, DC EPA-822-B-00-002. Washington, D. C.

USEPA, 2001. BASINS PLOAD Version 3.0 users manual. United States Environmental Protection Agency, Office of Water, Washington, DC.

Walker, William W. Jr. 2005. Estimation of water quality based effluent limits for measuring compliance with the Everglades phosphorus criterion. Draft for discussion purposes. 2005. 14 pages

Weaver, K. 2004. *Everglades Marsh Dissolved Oxygen Site Specific Alternative Criterion Technical Support Document.* Tallahassee, Florida: Florida Department of Environmental Protection.

Weaver, K., and G. Payne. 2004. Chapter 2A: Status of Water Quality in the Everglades Protection Area. G. Redfield (Ed.). In: *2004 Everglades Consolidated Report.* West Palm Beach, Florida: South Florida Water Management District.

Weaver, K., G. Payne, and S. Xue. 2007. Chapter 3A: Status of Water Quality in the Everglades Protection Area. G. Redfield (Ed.). In: *2007 South Florida Environmental Report – Volume I.* West Palm Beach, Florida: South Florida Water Management District.

Van Horn, Stuart and Doug Pescatore. 2007. Appendix 4-2: Water year 2006 permit-level data. 2007 South Florida Environmental Report. South Florida Water Management District. West Palm Beach, Florida.

APPENDIX A: Summary of Everglades WBIDs. Draft TMDLs due September 30, 2007 are shaded in yellow.

WBIDs	WBID NAME	1998 303(d) WBID	Waterbody Type	EVERGLADES LONG-TERM PLAN BASIN NAME	Nutrient TMDL on 1998(d) list	CD YEAR NUTRIENT TMDL DUE	Designated Use	Outstanding Florida Water?
WITHIN EVERGLADES PROTECTION AREA								
LOXAHATCHEE NATIONAL WILDLIFE REFUGE								
3252B	WCA1 north sector A	Unchanged	Everglades Marsh	NA	YES	2007	Class III	YES
3252D	WCA1 west sector	Unchanged	Everglades Marsh	NA		NONE	Class III	YES
3252	WCA1 center sector	Unchanged	Everglades Marsh	NA	YES	2012	Class III	YES
3252G	WCA1 east sector A	Unchanged	Everglades Marsh	NA	NO	NONE	Class III	YES
3252E	WCA1 south sector	Unchanged	Everglades Marsh	NA	YES	2012	Class III	YES
3252H	LOXA west sector		Everglades Marsh	NA	NO	NONE		
WATER CONSERVATION AREA 2								
3265G	WCA2A center sector	3265A, 3265E, 3265D, 3265	Everglades Marsh	NA	YES	2012	Class III	YES
3265H	WCA2A center sector	3265B, 3265E, 3265D, 3265	Everglades Marsh	NA	YES	2007	Class III	YES
3265F	WCA2A center sector	3265B, 3265D	Everglades Marsh	NA	YES	2007, 2012	Class III	YES
3272	WCA2B	Unchanged	Everglades Marsh	NA	YES	2012	Class III	YES
WATER CONSERVATION AREA 3								
3268H	WCA3A south sector	3268, 3268A, 3268B, 3278A	Everglades Marsh	NA	YES	2012	Class III	YES
3268I	WCA3A south sector	3268, 3268B, 3268C	Everglades Marsh	NA	YES	2012	Class III	YES
3268G	WCA3A south sector	3268, 3268B, 3268C, 3268D	Everglades Marsh	NA	YES	2012	Class III	YES
3268F	WCA3A south sector	3278A	Everglades Marsh	NA	YES	2012	Class III	YES
3268J	WCA3A south sector	3278, 3278E	Everglades Marsh	NA	YES	2012	Class III	YES
EVERGLADES NATIONAL PARK								
3289J	ENP L-67 culvert US 41	Unchanged	Everglades Marsh	NA	NO	NONE	Class III	YES
3289	ENP Shark Slough	Unchanged	Everglades Marsh	NA	YES	2008	Class III	YES
3289K	ENP Taylor Slough	Unchanged	Everglades Marsh	NA	NO	NONE	Class III	YES
3303	C-111	Unchanged	Everglades Marsh	NA	NO	NONE	Class III	YES
3261B	Tamiami Canal	Unchanged	Big Cypress Swamp	NA	NO	NONE	Class III	YES

WBIDs	WBID NAME	1998 303(d) WBID	Waterbody Type	EVERGLADES LONG-TERM PLAN BASIN NAME	Nutrient TMDL on 1998(d) list	CD YEAR NUTRIENT TMDL DUE	Designated Use	Outstanding Florida Water?
WBIDS DISCHARGING INTO THE EVERGLADES PROTECTION AREA								
FROM EAA (NORTH)								
3233			Canal, Farms	L-8	NO	TMDL done under LO tribs	Class III	NO
3238E	M canal		Canal, Farms	S-5A	NO	NONE	Class III, IV	NO
3238	West Palm Beach Canal		Canal, Farms	S-5A	NO	NONE	Class III, IV	NO
3244	East Beach		Canal, Farms	NA	NO	NONE	Class III, IV	NO
3247	715 Farms		Canal, Farms	NA	NO	NONE	Class III	NO
3249	East Shore		Canal, Farms	NA	NO	NONE	Class III	NO
3248A	Hillsboro Canal		Canal, Farms	S-7/S-2	YES	2012 2006	Class III, IV	NO
3252A	Knights Farm field 1		Canal, Farms	S-5A	YES	2007	Class III, IV	NO
3254	Hillsboro Canal		Canal, Farms	S-6	YES	2012	Class III, IV	NO
3253	South Bay		Canal, Farms	NA	NO	NONE	Class III	NO
3248	North New river canal		Canal, Farms	S-2/S-7	NO	NONE	Class III, IV	NO
3263	S-7		Canal, Farms	S-7	YES	2007	Class III, IV	NO
3263A	Holeyland		Everglades Marsh-not in EPA	S-7	YES	2012	Class III	YES
3260B	Holeyland		Everglades Marsh-not in EPA	S-8	NO	NONE	Class III	YES
3250	S-236		Canal, Farms	NA	YES	2012	Class III	NO
3251	S-3		Canal, Farms	S-3/S-8	NO	NONE	Class III, IV	NO
3260	S-8		Canal, Farms	S-8	YES	2007	Class III, IV	NO
FROM WEST								
3255			Canal, Farms	C-139	NO	NONE	Class III	NO
3260A	L3		Canal, Farms	S-8	YES	2012	Class III	NO

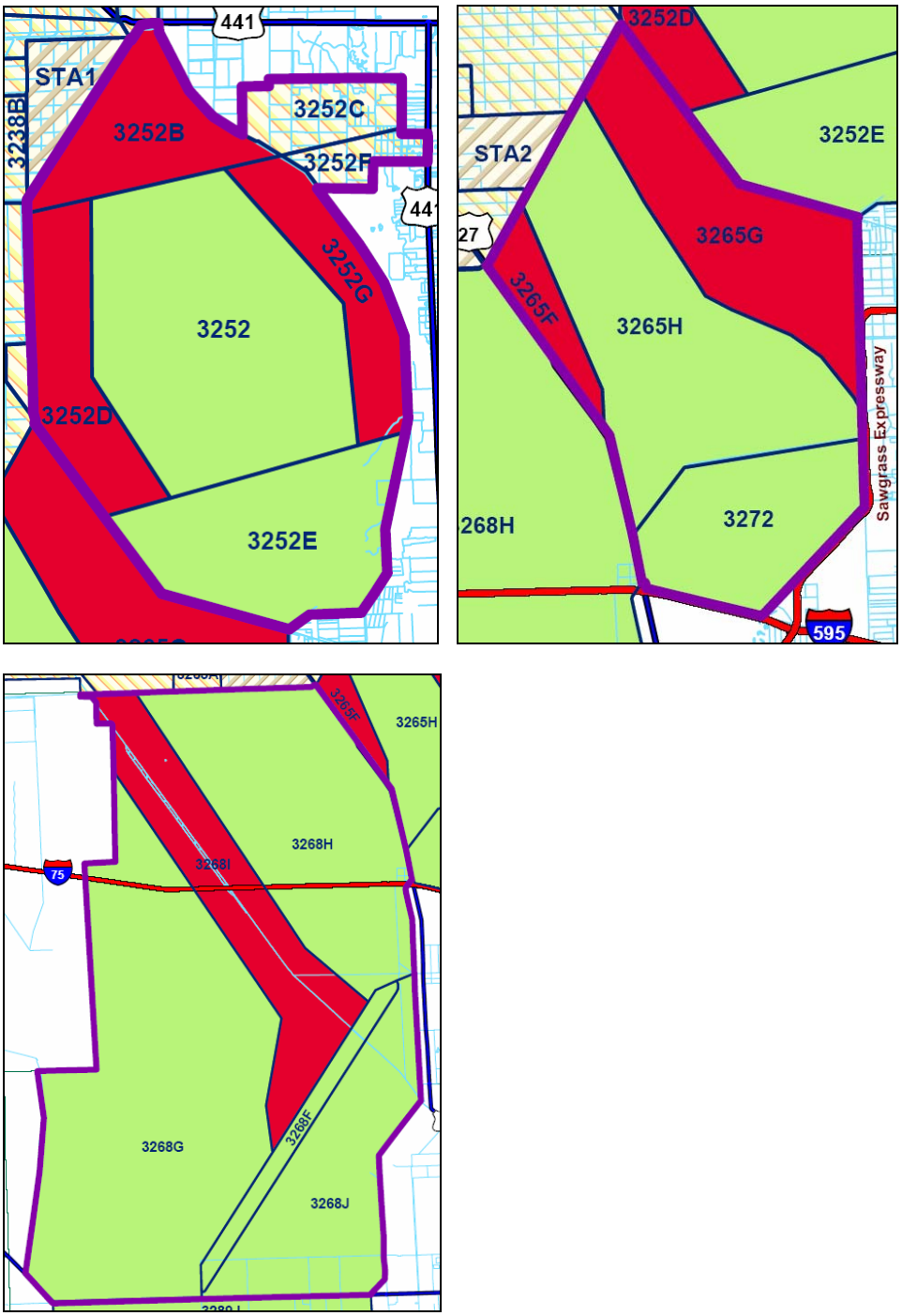
WBIDs	WBID NAME	1998 303(d) WBID	Waterbody Type	EVERGLADES LONG-TERM PLAN BASIN NAME	Nutrient TMDL on 1998(d) list	CD YEAR NUTRIENT TMDL DUE	Designated Use	Outstanding Florida Water?
3266	L28 Interceptor		Canal, Farms, Seminole Reservation, Miccosukee Reservation	L-28	YES	2012	Florida Class III, Miccosukee Class Seminole Class	NO
3267			Canal, Farms	Feeder Basin	NO	NONE	Class III	NO
3269	L-28 gap		Big Cypress Swamp	NA	NO	NONE	Class III	YES
3261B			Big Cypress Swamp	NA	NO	NONE	Class III	YES
FROM EAST								
3252C			Canal, Farms		YES	2007		
3252F			Canal, Farms	ACME B	YES	2012	Class III	NO
3264			Urban	NSID	NO	NONE	Class III	NO
3275			Urban	NNRC	NO	NONE	Class III	NO
3277C			Urban	NNRC	YES	2011	Class III	NO
3277			Urban	NNRC	YES	2011	Class III	NO
3277B			Urban	NNRC	NO	NONE	Class III	NO
3280			Urban	NNRC	NO	NONE	Class III	NO
3279			Urban	C-11W	YES	2011	Class III	NO
3301			Urban		NO	NONE	Class III	NO
3303A			Urban		NO	NONE	Class III	NO

WBIDs	Jurisdictional Government	CWA State	Structures discharging into WBID?	Structure permit?	Numeric TP discharge limit in permit	EPA 4-part test station?	Soil TP > 500 mg/kg	Annual SW TP > 15 ppb annual	Cattail present EMAP UF	Impaired Florida Group 5?	Impaired USEPA?
WBIDS WITHIN EVERGLADES PROTECTION AREA											
LOXAHATCHEE NATIONAL WILDLIFE REFUGE											
3252B	DOI - USFWS	Florida	G-300, G-301, STA1E, STA1W	NPDES, EFA;G300, G301 No	No	Impacted 3	YES	YES	Some	5 YES	YES
3252D	DOI - USFWS	Florida	None	NA	NA	Impacted 1	YES	YES	Dominant	5 YES	YES
3252	DOI - USFWS	Florida	None	NA	NA	Unimpacted 8	No	No	No	2	NO
3252G	DOI - USFWS	Florida	ACME	Non-ECP	No	Impacted 2; Unimpacted 2	-	YES	Some	5 YES	YES
3252E	DOI - USFWS	Florida	None	NA	NA	Unimpacted 4	Some	No	Some	2	NO
3252H	DOI - USFWS	Florida	None	NA	NA	NA	NA	NA	NA	NA	NA
WATER CONSERVATION AREA 2											
3265G	Florida	Florida	STA2, S-10s	NPDES, EFA	No	Impacted 3	YES	YES	Dominant	5 YES	YES
3265H	Florida	Florida	None	NA	NA	Unimpacted 5	Some	No	Some	2	NO
3265F	Florida	Florida	S-7, STA2	NPDES, EFA	No	No	Some	No data	Some	5 YES	YES
3272	Florida	Florida	S-144, S-145, S-146	Non-ECP	No	No	No	No data	Some	2	NO
WATER CONSERVATION AREA 3											
3268H	Florida	Florida	S-11s, S-7, STA3/4	NPDES, EFA	No	Unimpacted 3; Impacted 1; gap in north	YES		YES	2	YES- split WBID
3268I	Florida	Florida	S-8	NPDES, EFA	No	Impacted 2	YES	YES	YES	5 YES	YES
3268G	Florida	Florida	None	NA	NA	Unimpacted 4	Some	No	No	2	NO
3268F	Florida	Florida	S-9	Non-ECP	No	No	No	No data	Some	2	NO
3268J	Florida	Florida	S-9	Non-ECP	No	Unimpacted 3; gap in north	Some	No data	Some	2	YES- split WBID

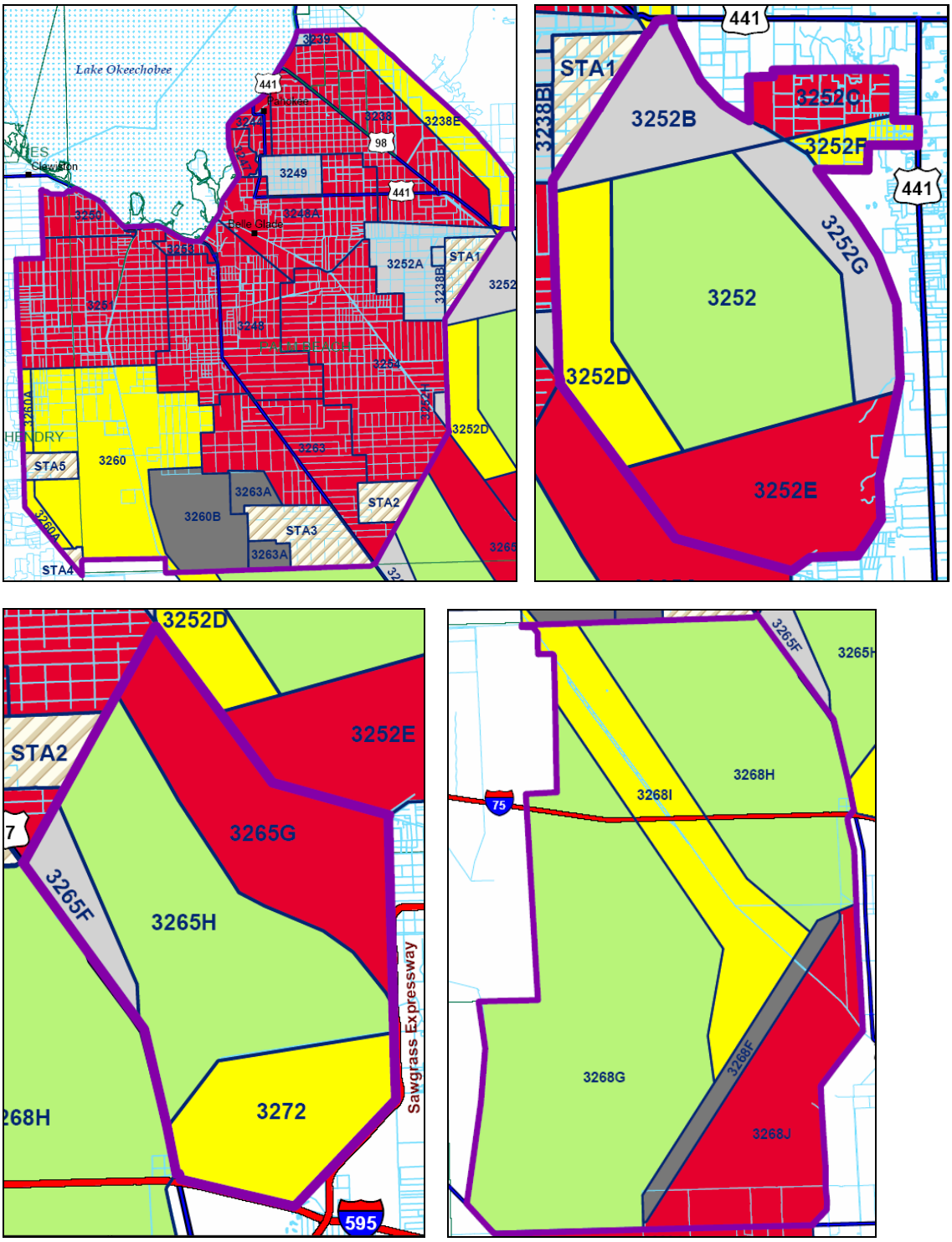
WBIDs	Jurisdictional Government	CWA State	Structures discharging into WBID?	Structure permit?	Numeric TP discharge limit in permit	EPA 4-part test station?	Soil TP > 500 mg/kg	Annual SW TP > 15 ppb annual	Cattail present EMAP UF	Impaired Florida Group 5?	Impaired USEPA?
EVERGLADES NATIONAL PARK											
3289J	DOI - NPS, Miccosukee Tribe	Florida; Miccosukee Tribe	S-12A-D, S-333, S-355A-B	No	No	NA	Some	No marsh data; S!2s No	Some	2	NO
3289	DOI - NPS	Florida	S-332s	Non-ECP	No	NA	Some	No	No	2	NO
3289K	DOI - NPS	Florida	S-332s			NA	No	No	No	2	NO
3303	DOI - NPS	Florida	S-18C, S-197	Non-ECP	No	NA	Some	No	No	Group IV YES	NO
3261B	DOI - NPS	Florida	None	NA		NA	NA	NA	NA	?	
WBIDS DISCHARGING INTO THE EVERGLADES PROTECTION AREA											
FROM EAA (NORTH)											
3233	NA	Florida				NA	NA	NA	NA		
3238E	NA	Florida				NA	NA	NA	NA		
3238	NA	Florida				NA	NA	NA	NA		
3244	NA	Florida				NA	NA	NA	NA		
3247	NA	Florida				NA	NA	NA	NA		
3249	NA	Florida				NA	NA	NA	NA		
3248A	NA	Florida				NA	NA	NA	NA		
3252A	NA	Florida				NA	NA	NA	NA		
3254	NA	Florida				NA	NA	NA	NA		
3253	NA	Florida				NA	NA	NA	NA		
3248	NA	Florida				NA	NA	NA	NA		
3263	NA	Florida				NA	NA	NA	NA		
3263A	Florida	Florida				NA	NA	NA	NA		
3260B	Florida	Florida				NA	NA	NA	NA		
3250	NA	Florida				NA	NA	NA	NA		
3251	NA	Florida				NA	NA	NA	NA		
3260	NA	Florida				NA	NA	NA	NA		
FROM WEST											
3255	NA					NA	NA	NA	NA		
3260A	NA					NA	NA	NA	NA		

WBIDs	Jurisdictional Government	CWA State	Structures discharging into WBID?	Structure permit?	Numeric TP discharge limit in permit	EPA 4-part test station?	Soil TP > 500 mg/kg	Annual SW TP > 15 ppb annual	Cattail present EMAP UF	Impaired Florida Group 5?	Impaired USEPA?
3266	Miccosukee Tribe, Seminole Tribe	Florida, Miccosukee Tribe, Seminole Tribe				NA	NA	NA	NA		
3267	NA	Seminole Tribe, Florida				NA	NA	NA	NA		
3269	DOI - NPS	Florida, Miccosukee Tribe, Seminole Tribe				NA	NA	NA	NA		
3261B	DOI - NPS	Florida, Miccosukee Tribe				NA	NA	NA	NA		
FROM EAST											
3252C		Florida				NA	NA	NA	NA		
3252F	NA	Florida				NA	NA	NA	NA		
3264	NA	Florida				NA	NA	NA	NA		
3275	NA	Florida				NA	NA	NA	NA		
3277C	NA	Florida				NA	NA	NA	NA		
3277	NA	Florida				NA	NA	NA	NA		
3277B	NA	Florida				NA	NA	NA	NA		
3280	NA	Florida				NA	NA	NA	NA		
3279	NA	Florida				NA	NA	NA	NA		
3301	NA	Florida		Non-ECP	NO	NA	NA	NA	NA		
3303A	NA	Florida		Non-ECP	NO	NA	NA	NA	NA		

APPENDIX B: Draft 2006 impairment determinations by FDEP

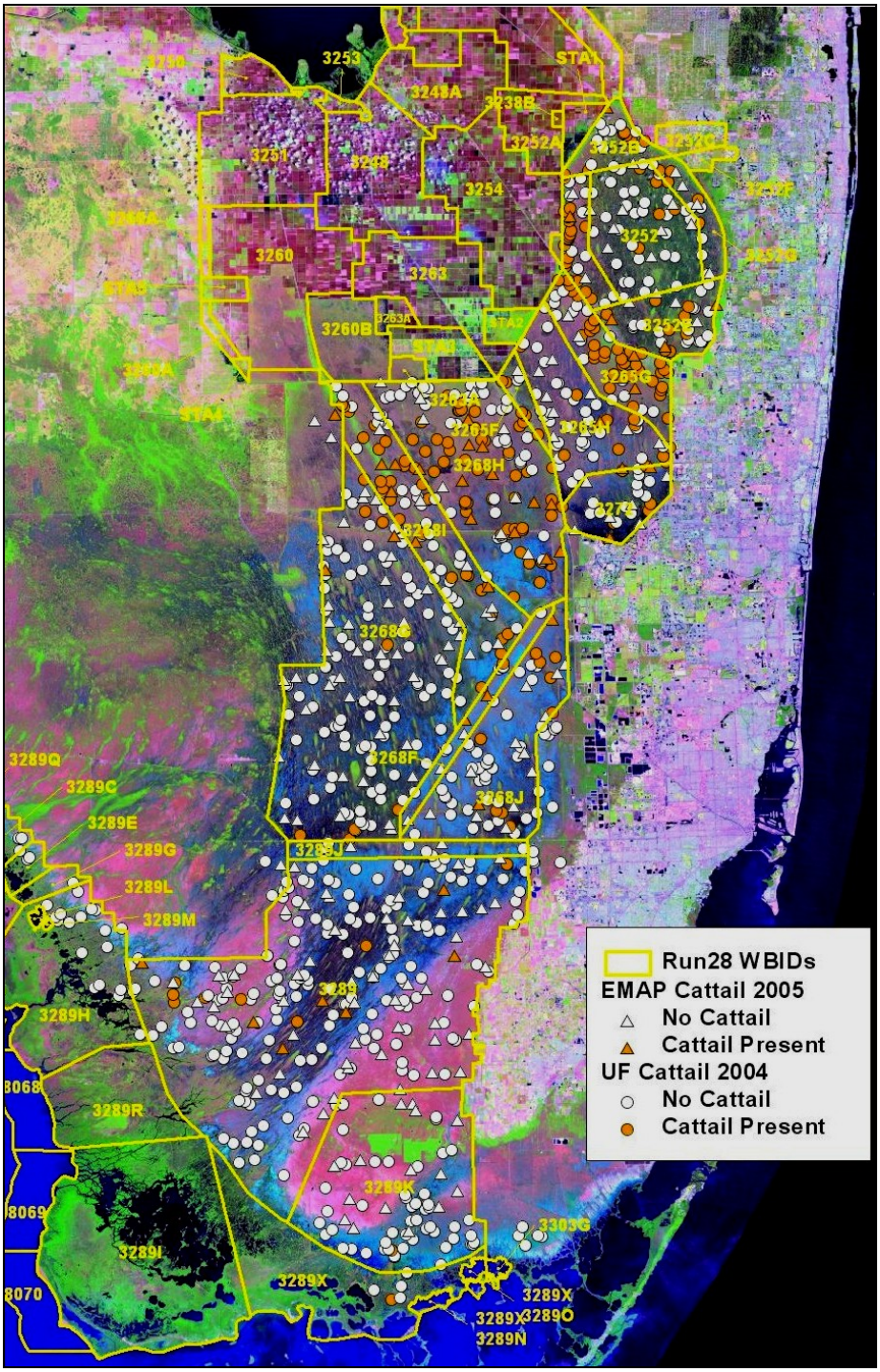


FDEP 2006 draft Group 5 verified list impairment determinations for phosphorus. Red indicates that the waterbody is impaired and a TMDL is required, green indicate that the waterbody is attaining all designated uses.

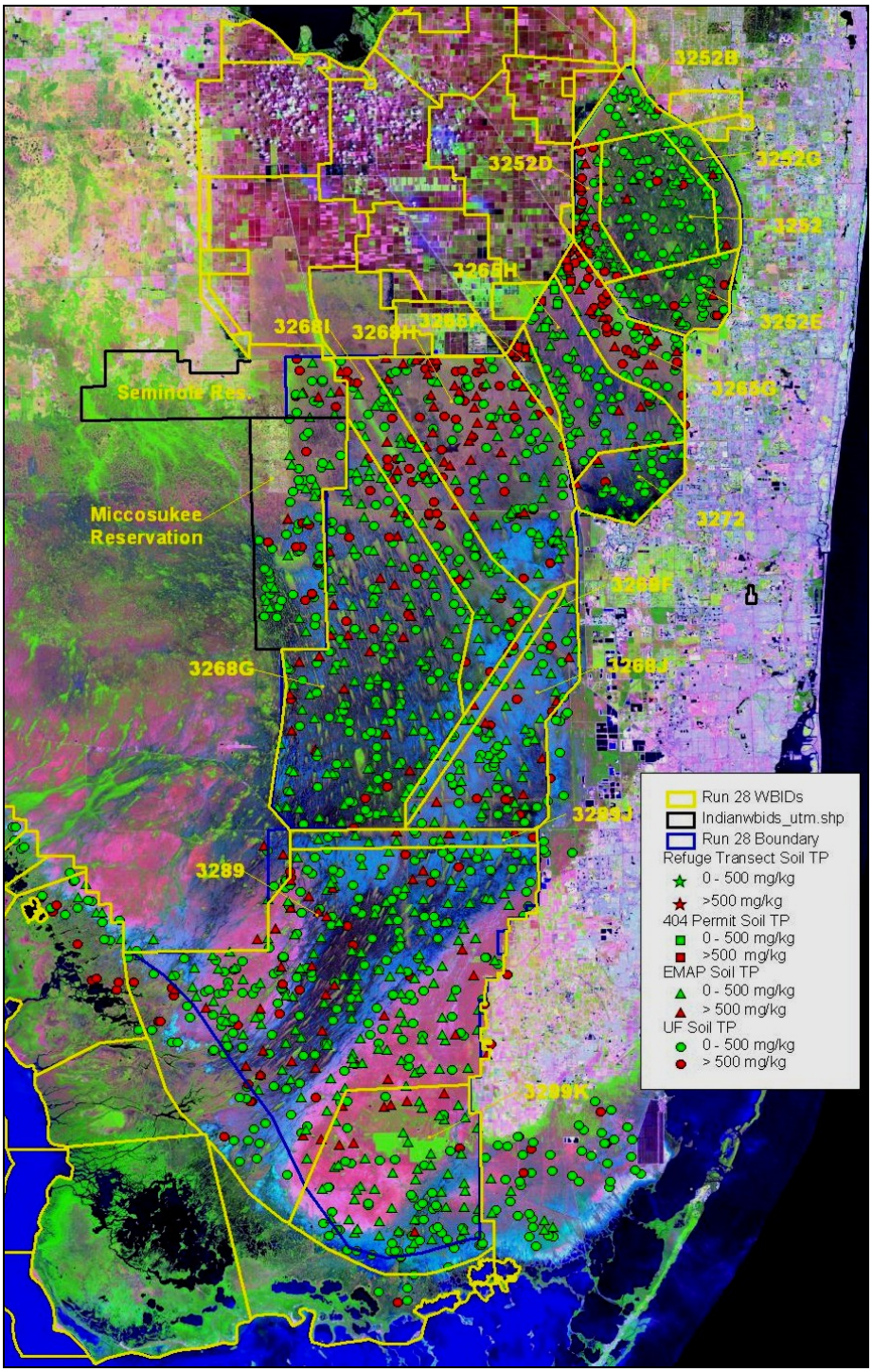


FDEP 2006 draft Group 5 verified list impairment determinations for dissolved oxygen. Red indicates that the waterbody is impaired and TMDL is required, green indicate that the waterbody is attaining all designated uses. Grey indicates insufficient data to make a determination, yellow indicates waterbody is potentially impaired.

APPENDIX C: Indicators of phosphorus impairment in the EPA.



Cattail presence throughout the EPA 2004-2005. Data are from the University of Florida, SFWMD and USEPA R-EMAP (Scheidt and Kalla 2007).



Soil TP concentration throughout the EPA 2004-2005. Data are from the University of Florida, SFWMD and USEPA R-EMAP (Scheidt and Kalla 2007).

APPENDIX D: Calculation of current water quality conditions

Discharges into the Refuge at WBID 3252B. Acre-feet are times 1000. Data are from Table 3.

WY	G300+G301 untreated			G251 STA1W outflow			G310 STA1W outflow			S362 STA1E outflow			Total			
	Flow	TP load	FWMC	Flow	TP load	FWMC	Flow	TP load	FWMC	Flow	TP load	FWMC	Flow	TP load	FWMC*	TP load at 16 ppb
	(ac-ft)	(mt)	(ppb)	(ac-ft)	(mt)	(ppb)	(ac-ft)	(mt)	(ppb)	(ac-ft)	(mt)	(ppb)	(ac-ft)	(mt)	(ppb)	(mt)
2002	11	1.6	118	7	0.2	19.8	261	12	37.3				279.0	13.8	40.0	5.5
2003	10	2.5	202	97	5.5	44.1	499	33.4	54.2				606.0	41.4	55.0	12.0
2004	17	3.1	148	55	3	44.2	243	14.1	46.9				315.0	20.2	51.9	6.2
2005	69	27	317	63	7.8	100.4	320	38.7	97.8	15.9	7.6	387.3	467.9	81.1	140.3	9.2
2006	47	14	242	34	4.5	107.4	104	14.7	115.1	40.54	7.3	145.7	225.5	40.5	145.9	4.4
Average													378.7	39.4	86.6	7.5

FWMC = flow-weighted mean concentration.
* FWMC is weighted by structure flow.

Discharges at S-7 into WBID 3265B. Data are from Table 4.

WY	S-7 to 9/3/04			S-7 after 9/3/04			Total			
	Flow	TP load	FWMC	Flow	TP load	FWMC	Flow	TP load	Average TP	TP Load at 16 ppb
	(1000 ac-ft)	(mt)	(ppb)	(1000 ac-ft)	(mt)	(ppb)	(1000 ac-ft)	(mt)	(ppb)	(mt)
2002	98	5.8	47.8				98.0	5.8	47.8	1.9
2003	143	9.6	54.5				143.0	9.6	54.5	2.8
2004	156	8.6	44.5				156.0	8.6	44.5	3.1
2005	132.89	3.4	20.8	176.8	2.6	11.8	309.7	6	15.7	6.1
2006				456.7	10.8	19.2	456.7	10.8	19.2	9.0
Average							232.7	8.16	36.34	4.6

Discharges from ACME basin B (WBID 3252C).

Water Year	TP Load (mt)			Flow-weighted TP (ppb)			Flow (1000 ac-ft)			Data source
	ACME 1	ACME 2	Total	ACME 1	ACME 2	Average	ACME 1	ACME 2	Total	
2002	1.7	3.3	5	89	152	120.5	16	18	34	Goforth et al., 2003
2003	0.9	1.4	2.3	80	117	98.5	9	9	18	Piccone et al., 2004
2004	0.9	1.2	2.1	72	101	86.5	10	10	20	Payne et al., 2005
2005	2	2.9	4.9	133	212	172.5	12.3	11.2	23.5	Payne et al., 2006
2006	1.4	1.8	3.2	80	116	98	14.2	12.8	27	Payne et al., 2007
Average			**3.52**			**115.2**			**24.5**	

FWMC = flow-weighted mean concentration.

TP conditions in EAA WBIDs

	3260 (S-8)			3263 (S-7)			3252A (Knight's Farm Field 1)			
Water Year	TP load	FWMC	AW FWMC*	TP load	FWMC	AW FWMC*	TP load	FWMC	AW FWMC*	Data Source
	(mt)	(ppb)	(ppb)	(mt)	(ppb)	(ppb)	(mt)	(ppb)	(ppb)	
2002		105.7	63.3		82.8	74.3		120.7	131.7	Sievers et al, 2003
2003		78.5	55.1		79	77.5		160.4	150.3	McGinnes et al, 2004
2004		61.1	48.7		72.7	72.8		135	129.8	McGinnes et al, 2005
2005	23.6	88.6	59.9	35.7	92	98.7	56.2	203.3	200.9	Pescatore and Vega, 2006
2006	46.7	125.8	86.3	54.2	123.2	145.7	49.5	204.8	227.5	Van Horn and Pescatore, 2007
Average	**35.2**	**91.9**	**62.7**	**45.0**	**89.9**	**93.8**	**52.9**	**164.8**	**168.0**	

* AW FWMC = Area weighted flow-weighted mean concentration. For example, TP concentration at a discharge from a 20,000 acre farm is weighted ten times the TP concentration for a 2000 acre farm

APPENDIX E: PLOAD model, EMC values and results

Average annual non-point source loads of nutrients were estimated using a spreadsheet based on EPA's Simple Method formula from the BASINS PLOAD model (EPA, 2001):

$$LP = \Sigma u\ (P * PJ * RVu * Cu * Au * 2.72 / 12)$$

Where: LP = Pollutant load, lbs

P = Precipitation, inches/year

PJ = Ratio of storms producing runoff (default = 0.9)

RVu= Runoff Coefficient for land use type u, inches of runoff/inches of rain

RVu=0.05 + (0.009 * Iu); Iu = percent imperviousness

Cu = Event Mean Concentration for land use type u, milligrams/liter

Au = Area of land use type u, acres

This method calculates nonpoint source loadings for nutrients as the product of the water quality concentration and runoff water volume associated with certain land use practices. An annual average rainfall of 50 inches was used. The default ratio of 0.9 for storms producing runoff was used. Land use data entered into the spreadsheet were based on the SFWMD land use/cover features categorized according to the Florida Land Use and Cover Classification System (FLUCCS). Event Mean Concentrations (EMCs) for each land use type in Florida were compiled by Harper and Baker (2003), and are provided below. 1999 land use was used for WBIDs 3260 and 3263, and 2004 land use was used for 3252A and 3252C.

PLOAD EMC values

FLUCCS ID	Land Use	Total P (mg/L)
1000	Urban Open	0.09
1100	Low Density Residential	0.09
1200	Medium Density Residential	0.09
1300	High Density Residential	0.09
2000	Agriculture	0.09
3000	Rangeland	0.09
4000	Forest/Rural Open	0.046
5000	Open Water	0.07
6000	Water/ Wetlands	0.09
7000	Barren land/Transition	0.09
8000	Communication and Transportation	0.09

PLOAD TMDL condition results

WBID	TP (mg/l)	TP (lb/yr)
3260	0.089	5467
3263	0.088	3915
3252A	0.087	1468
3252C	0.082	127